FOR USE IN EXPERIMENTAL SCHOOLS ONLY

BIOLOGY

TEACHING MATERIALS

for

CLASS VII

(EXPERIMENTAL EDITION)

DEPARTMENT OF SCIENCE EDUCATION
NATIONAL COUNCIL OF EDUCATIONAL
RESEARCH AND TRAINING

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PREFACE

In 1964 a UNESCO Planning Mission visited this country and made certain recommendations for effecting improvements in the teaching of science and mathematics in the Indian schools. The National Council of Educational Research and Training has taken up the task of implementing some of these recommendations. One of these tasks is the development of new syllabi for teaching science as individual disciplines of physics, chemistry and biology from the very beginning of the middle stage instead of the present arrangements of teaching the subjects as general science. The Indian Education Commission, 1966, has also felt that the teaching of science in the middle stage has not been satisfactory and has suggested that the teaching of science at this level should be in the form of separate disciplines of Physics, Chemistry and Biology. It is necessary that new syllabi and textbooks in science and mathematics should be prepared to implement this suggestion. The UNESCO has provided the necessary assistance in the form of experts to help the Department of Science Education in developing new syllabi and teaching materials in mathematics and science subjects.

The Department of Science Education is currently engaged in preparing the syllabi for the middle stage in various subjects of science and mathematics and also the text and other guidance materials. These materials are to be tried out in selected schools before they are finalised and made available for wider use.

The Delhi Education Directorate has very kindly cooperated in allowing the try out of these materials in about 30 selected schools of Delhi for which this Department is grateful.

The syllabi and the text materials in this project are based on the pattern of the materials used in the schools of the USSR where science is taught as individual disciplines from the beginning of the middle stage. The nature of this curriculum is such that it has a practical bias and all knowledge of science is imparted through experimental activities by the teachers and pupils. Due care has been taken to present the correct and up-to-date facts of science and examples from Indian situations have been given. These materials will be finally revised on the basis of the experience gained in the course of this project.

I am grateful to the UNESCO experts and to my colleagues in the Department who have worked hard in developing these text materials. It is hoped that the teachers will use this material in the experimental spirit and will help us with their valuable criticism so that the final editions may be revised in the light of their first hand experience to give it the form of a textbook.

New Delhi
August, 1967

R. N. RAI
Head of the Department

CHAPTER I

Diversity of Plants

We have been studying how a flowering plant lives. But are the common green garden plants, the grasses, the tall flowering trees, the only plants around us ? Oh no! There are millions and millions of plants green and non-green around you. Most of them bear flowers, fruits and seeds; have stem, roots and leaves; and are green in colour. Others are non-green such as the mushrooms and the toadstools. Some plants are very big while others may be so small that they cannot be seen with a naked eye. Some may live on land, some in water yet others under the great depths of the ocean. Well then, let us look around and find out what they are and where they are found, and how they live.

§ 1. BACTERIA

Have you ever seen milk becoming sour if left overnight on a warm day ? You might wonder what has gone wrong with the milk. This souring of milk is brought about by some tiny organisms known as bacteria. These are very small and not visible to the naked eye. They can be seen only under the microscope when magnified at least 500 times.

Occurrence

These organisms are found everywhere, in any condition where life can exist or even in conditions where normal existence of life is difficult. They are present in the air we breathe, in the water we drink and in the food we eat. They are present in the soil, in the living organisms as well as in dead organic matter. In our mouth alone there are many varieties of bacteria. Let us try to see them.

Take some scraping of the tooth with a tooth pick, spread

it on a glass slide and examine it under the microscope. (Stain it with crystal violet). You will see thousands of bacteria.

Soak some hay in water and keep it overnight. Pour off the upper clear liquid. Keep this liquid for some time. After some days white slimy matter will appear on top of the liquid. Put a drop of this matter and examine it under a microscope. You will see a lot of bacteria, most of them being rod-shaped. Among them you will see the hay bacteria. They are bigger than other bacteria. They are rod-shaped, and single celled. Each of them has a wall around itself which helps to maintain its shape. Inside the cell is the protoplasm. For a long time it was thought that a bacterial cell has no nucleus. It has, however, been found that the bacterial cell has a nucleus. But this nucleus is not of the same type as you have seen in other plant cells.

Structure of a Bacterial Cell

Bacteria may vary greatly in shape and size. Most of them are rod-shaped. Bacteria may also be in the form

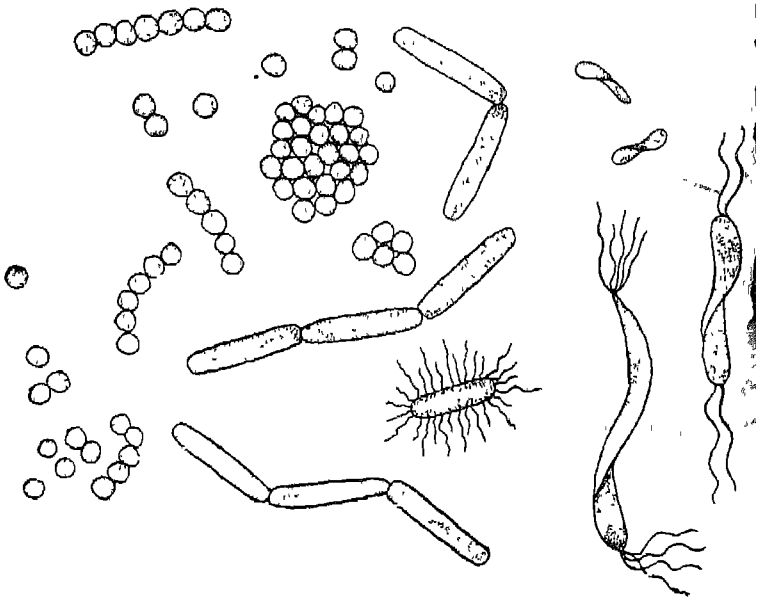

Fig. 1.1. Bacteria of different shapes

of spheres, comma-shaped or spiral. Some of the bacteria have hair-like structures on their body called cilia or flagella. Bacteria are very small in size. They are measured not in millimetres but in fractions of a millimetre. Actually they are measured in microns. A micron is 1/1000 of a millimetre. So you can imagine how small they are.

Nutrition in Bacteria

Let us now see how the bacteria obtains their food. Most bacteria are colourless. They cannot manufacture their own food since they do not have chlorophyll in their cells. They live on other organic substances already prepared. Some bacteria live on the tissues of living animals or plants, and absorb the prepared food from the host cells. These are called **parasites**. Other types of bacteria live on the dead and decaying tissues of plants and animals. These are called **saprophytes**. In the soil all dead organic matter is decomposed by the action of bacteria and is reduced to simpler substances. Some bacteria cause a number of diseases such as cholera, diptheria and typhoid. Bacteria may also cause diseases of plants and animals. There are also useful bacteria in our body. You may learn about this in your later classes.

Reproduction in Bacteria

The bacteria increase in number by simple division of their cells. This method is known as fission. In this a single bacterial cell divides into two by a simple cell division. The divided cells remain separate. Occasionally they may be attached to one another forming small chains (Fig. 1.2). Under favourable conditions bacterial cells divide very rapidly. A single cell of cholera bacterium divides once every 20 minutes. The two new cells formed grow to the normal size and divide again. Try to work out how many bacterial cells will be there after 24 hours. In $1\frac{1}{2}$ days as many bacterial cells will be formed as to fill 1,000 trucks. But such unlimited increase does not happen in nature because of limited food, space and other con-

ditions which check growth.

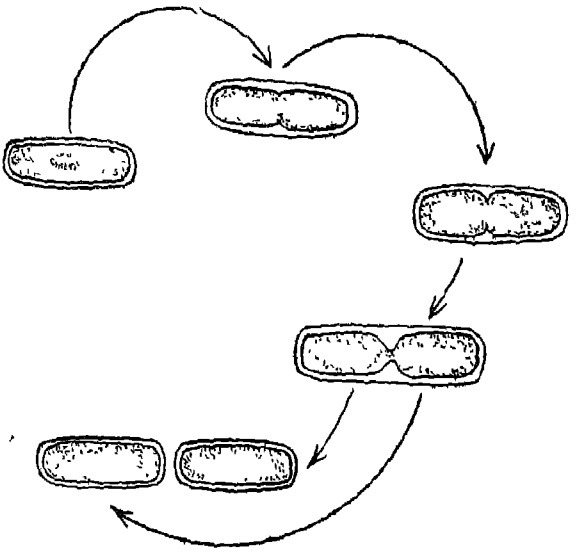

Fig. 1.2. Reproduction in bacteria

How do Bacteria Resist Unfavourable Conditions ?

The bacteria do not always live in favourable co... Sometimes the food may not be available or the temperature may be very high or very low. The bacterial cell then forms a thick wall around itself. In this condition they are known as spores. The spores are very interesting. Just like seeds, the spores can remain alive for a long time. When favourable conditions return they germinate. In the form of spores the bacteria can withstand extremes of temperature such as boiling or freezing etc.

The Role of Bacteria in Nature

We have seen how the bacteria look like, how they live, and how they increase in number. Let us see how they are related to our life. These tiny creatures are our great friends and some of them are our great enemies. In nature some bacteria help in the decomposition of the dead animal and

plant matter and breaking them into simpler substances. Some bacteria also cause spoilage of food. Food kept in warm, moist places get spoiled very soon. Spoilage of the food can be prevented by heating, so that the spores get killed and these heated products are then placed in sealed tins. This is the method employed in canning industry. Do you know how jam is made at home ? The fruit is heated and a lot of sugar is added to it. In this condition the jam remains without being spoiled by bacteria. Food products can also be prevented from decay by freezing, or by adding excess of sugar or salt.

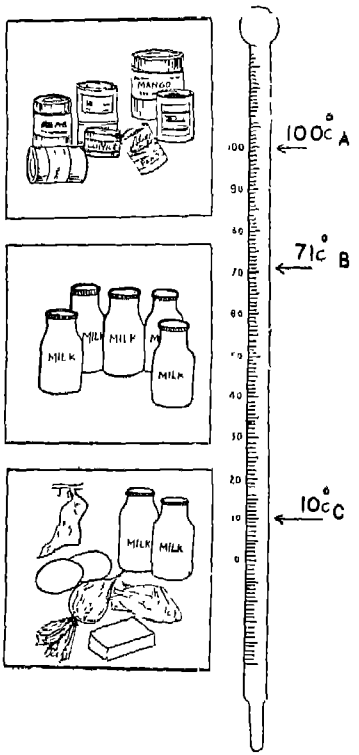

Fig. 1.3. Prevention of spoilage by bacteria

Under high salt or sugar concentration the bacterial cell cannot live and hence cannot grow. In the making of butter and other

dairy products bacteria play a prominent part. They are also useful in the vinegar industry, tanning of leather, curing of tea and in the manufacture of vitamins.

Many useful bacteria are present in the soil too. One gram of soil may contain as many as one million to 100 million bacteria depending upon the organic content of the soil. Have you ever seen the gardener collecting the fallen leaves and other plants and dumping them in one place and covering them with a little mud ? When he leaves those plant parts in one place the soil bacteria by their action convert them into a substance called 'humus'. This is dark in colour and powdery. In the presence of oxygen the humus is changed by another set of bacteria into mineral substances. These minerals are taken up by plants. Thus bacteria help to maintain the fertility of the soil. Sometimes we collect the leaves and twigs from the garden and burn them. This is, not a good practice. In fact we should add lots of organic substance to the soil to promote bacterial growth and thus make the soil fertile.

Imagine what will happen to all the dead plants and animals left on soil if the bacteria do not act on them and reduce them to simpler substances. Soon the earth's surface will be full of dead plants and bodies of animals. All these grow by taking food materials from the soil. The soil has become poorer to that extent and new plants will not have the necessary minerals. Bacteria, by decomposing dead plants and animals, return back the minerals taken earlier from the soil.

Pull out a bean or pea plant. Do you see some small swellings on the roots ? These are called nodules (Fig. 1 4). Some bacteria live in these nodules. These bacteria help the soil to be rich in nitrogenous compounds. The nitrogen present in the atmosphere is of no help to plants These bacteria change this nitrogen into such a form that it can easily be taken up by the plant. The root nodule bacteria along with other bacteria form a part of the nitrogen cycle.

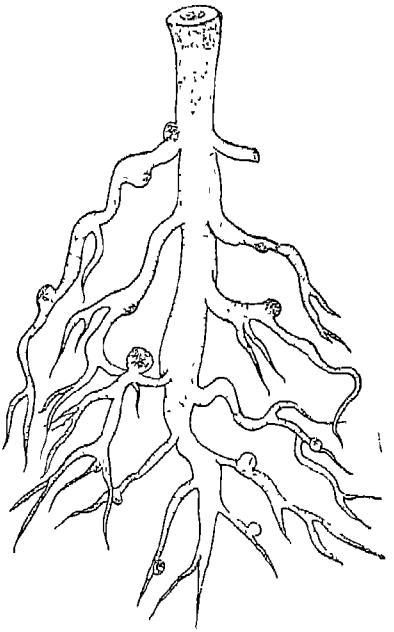

Fig. 1.4. Root nodules on leguminous plants

Bacteria that Cause Diseases

We have seen how the bacteria are helpful to us. But all of them are not our friends. Some of them cause dreadful diseases in man, others cause diseases to his domestic animals and to the crop plants thus causing heavy damage.

We all know that many diseases are caused by some organisms known as germs. In olden days people used to think that diseases are caused by the anger of some Gods or due to some supernatural causes. Instead of treating the disease they were trying to please God. Today, thanks to the knowledge of science, we know how to cure and how to prevent these diseases. Some of the diseases caused by bacteria are tuberculosis, cholera, typhoid, pneumonia etc. These bacteria, when they enter the body produce poisons. Illness is caused when the poison spreads in the blood stream.

When a person suffers from bacterial diseases he takes

certain drugs. These drugs help to fight the bacteria. Thus the body becomes free from the disease. Medicines which are used for killing microbes in general are known as antibiotics. One of the most common antibiotic that you know is penicillin. Sunlight also is a natural agent for killing bacteria.

SUMMARY

Bacteria are one of the simplest of living organisms. Their body structure is very simple made up of only one cell. They are very small and can only be seen when enlarged 500 times. The unit used for their measurement is called a micron. They may be of various shapes such as rod-shaped, spherical and comma shaped. Some of them have cilia for their movement. Bacteria may either obtain their food from the prepared organic food-stuffs while some of them can prepare their own food either with the help of sunlight or some chemicals. Bacteria reproduce by simple fission. Bacteria tides over unfavourable condition by forming spores. Bacteria are of great importance in nature. They are both helpful and harmful to us. Soil bacteria help in increasing the fertility of the soil. Others act as scavengers. They are helpful in dairy and vinegar industry. Spoilage of food by bacteria can be prevented by pickling, salting, freezing etc. Some bacteria, however, cause dreadful diseases.

Questions

1. How does a bacterial cell look like ? What are the various shapes of bacteria ? Draw figures of them.
2. Where do you find bacteria ?
3. In what ways are bacteria useful or harmful to us ?
4. How can we prevent the spoilage of the food by bacteria ?

Task

Soak some gram seeds. Keep it for some days till the water on the top becomes turbid. Put a drop of this liquid on the slide and examine it. Make drawings of the bacteria that you see.

§ 2. ALGAE

Have you ever seen the green 'scum' on the surface of a pond ? Take a glass of that pond water with the scum and see it against a bright light. You will see a large number of tiny green organisms moving in it. You may also see some green thread-like material. All this may be seen only if you use a hand lens. These green organisms are called **algae**. They are a group of the simplest and the most primitive members of the plant kingdom. They generally grow in water or where there is a wet surface. These organisms have green colouring matter, the chlorophyll. They can make their own food like the green leaves of plants. All algae are not green; some are blue-green, some brown and still others are red in colour. They have different coloured pigments in them in addition to chlorophyll.

Occurrence

Algae are found mostly in water. They are present in ponds, pools and ditches. Some of them occur in sea particularly the red and the brown algae. These are popularly called the sea-weeds. Those of you who live near the sea coast would have seen the sea-weeds occasionally cast on the sandy shore. A few of the algae are terrestrial growing on wet soil, rock and on other wet surfaces. Some algae can grow in hot springs. Some are known to grow even on snow. Yet others grow on the shells of water animals.

Range of Structure

The algae may be of various shapes and sizes. Some are very small and their plant body consists of a single cell. Such forms are said to be unicellular. Some are thread-like and still others are massive and large.

Soon after rains, water collects in ponds and ditches. Watch out for the appearance of green colour or scum on this water. Examine a drop of such water under a microscope. You may see many unicellular algae. Do you find small egg-

shaped one-celled organisms moving about briskly? These are likely to be *Chlamydomonas.*

Chlamydomonas

The alga has a body which is made up of only one cell. It is egg-shaped. The cell has a cell wall which surrounds the body. There are two fine thread-like structures at the front end. These are the cilia. By the continuous lashing of the cilia the organism is able to move. Inside the cell wall there is cytoplasm and in it a nucleus. This nucleus, however, can only be seen when you examine a preserved and prepared slide. On the lower portion of cell there is a green cup-shaped structure. This is the green chloroplast. The organism is able to make its food with the help of the chloroplast. The process

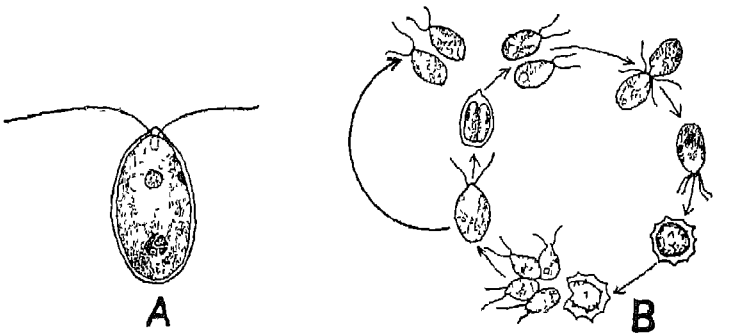

Fig. 1 5. *Chlamydomonas* · A simple unicellular green alga
B Stages in the life history

is the same as in the green leaf. There is a small red-spot present in the front end of the body. This is the 'eye spot' which is supposed to help the organism to find its direction (Fig. 1.5).

The *Chlamydomonas* absorbs water, mineral salts and carbon dioxide from the water surrounding it through the body surface. The organism also respires by absorbing oxygen which is dissolved in water.

How does it increase in numbers? Increase in numbers takes place in two ways. In the first case the contents of the

body of the *Chlamydomonas* divides into two, four or eight small units. The mother wall then dissolves and these units escape into the water. These smaller units resemble the mother cell in their structure. These are called **zoospores**. In the second method of reproduction a *Chlamydomonas* cell forms a large number of tiny units each with a pair of cilia. These are called the **gametes**. The gametes fuse in pairs. After fusion the joint cell develops a thick wall. This thick wall protects the inner cell contents. The cell is now called the **zygote**. The zygote with its thickwall is able to tide over difficult conditions. When favourable conditions return the contents of the zygote divide into a number of small *Chlamydomonii*. The wall of the mother cell dissolves and the tiny *Chlamydomonii* are set free.

Filamentous Algae

Collect some green scum from the surface of the pond and bring it to the class room. Spread it on a glass plate. You will see a large number of green filamentous algae. Among them the most common is *Spirogyra*. Put a bit of this and examine it under the microscope. Each *Spirogyra* thread is made up of rows of cells placed end to end. This thread is called a filament. A single cell of *Spirogyra* is cylindrical with two ends walls (Fig. 1.6). If you examine the cell of *Spirogyra*

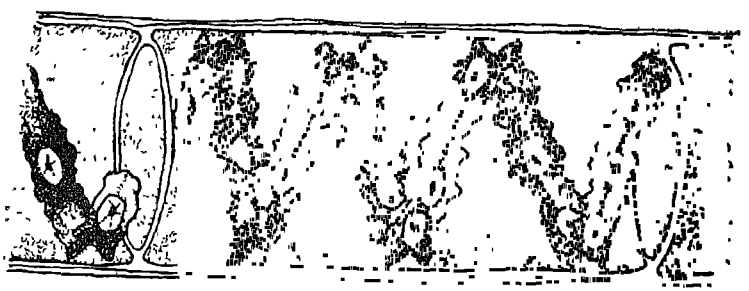

Fig 1.6. *Spirogyra* : A filamentous green alga

under the high power of the microscope you will see that the cytoplasm forms a layer next to the cell wall. In the centre of

the cell is a huge vacuole filled with a liquid. In the centre of this vacuole is the nucleus· It appears to be suspended by means of cytoplasmic threads. Arranged spirally and coloured green is a ribbon shaped chloroplast. More than one ribbon may be present in a cell.

Let us now see how these filaments increase in number. Sometimes due to water currents or otherwise the filaments of *Spirogyra* breaks into smaller lengths and then each part grows into a new filament. The cells divide and their number increase adding length to the filaments. This method of reproduction is called fragmentation. Sometimes the cells of one filament get connected to an opposite cell in the neighbouring filament by means of a tube (Fig. 1.7). The contents of the cells round

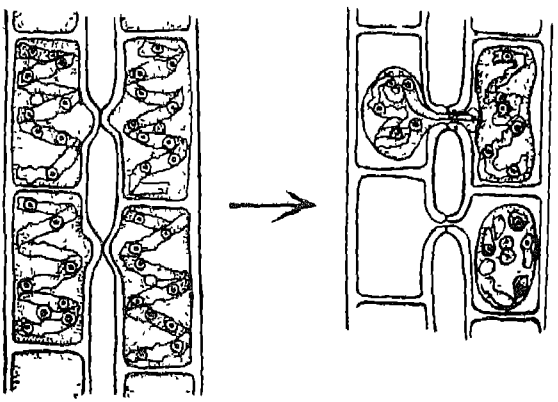

Fig. 1.7. Reproduction in *Spirogyra*

up and one of them goes over to the opposite cell and fuses with the contents there. The fused contents develop a thick wall and form a zygote. The contents of each of the cell is a gamete and because two gametes fuse, the reproduction here is sexual reproduction. The zygote remains intact even after the cells degenerate. The zygote germinates and from each zygote a new filament is formed.

Uses of Algae

Algae are very useful to men, plants and animals. While

making food for themselves they produce oxygen. This oxygen is very useful for the animals and fishes living in the water of ponds. In oceans also we find tiny green algae. These also liberate oxygen much of which escapes into the atmosphere. Thus the atmosphere gets replenished with oxygen.

Some of these small algae are also eaten by small insects and other animals living in water. These animals are in turn eaten by bigger animals. The bigger animals are eaten by small fishes. Bigger fish eats smaller fish and ultimately the fish is eaten by man. Thus there is a regular chain as follows. Tiny plants—→animals—→smaller fishes—→bigger fishes —→men. Such a chain is known as a food chain. These tiny plants are very important because they form the basic or the first link in this chain. Other animals are dependent directly or indirectly on them. Thus we find that these tiny plants are very useful to us. There is a wonderful correlation between the algae and fishes. Man also uses some algae as food. In China and Japan people use various sea weeds as food. A gelatinous material called agar-agar is extracted commercially from red algae. It is used in medicine as a laxative and also in the making of fruit jellies and ice cream. Agar-agar is also used as a jelly-like medium on which fungi and bacteria can be grown. Algin is another product which is obtained from sea weeds. This is also useful in industries. The ash left after sea weeds are burnt is rich in potash. Formerly potash used to be manufactured by burning sea weeds. Sea weeds are rich in iodine and formerly iodine was obtained from sea weeds. Dry sea weeds can also be used as fertilizers. Some algae can fix atmospheric nitrogen. In this they are like those bacteria which live in the root nodules of leguminous plants.

SUMMARY

Algae are the simplest type of plants. They are mostly found in water. Vast majority of them are green in colour. They may be blue, green, brown or red in colour. They are either unicellular or multicellular forms. Some of them are very big. They differ from the bacteria in having chlorophyll.

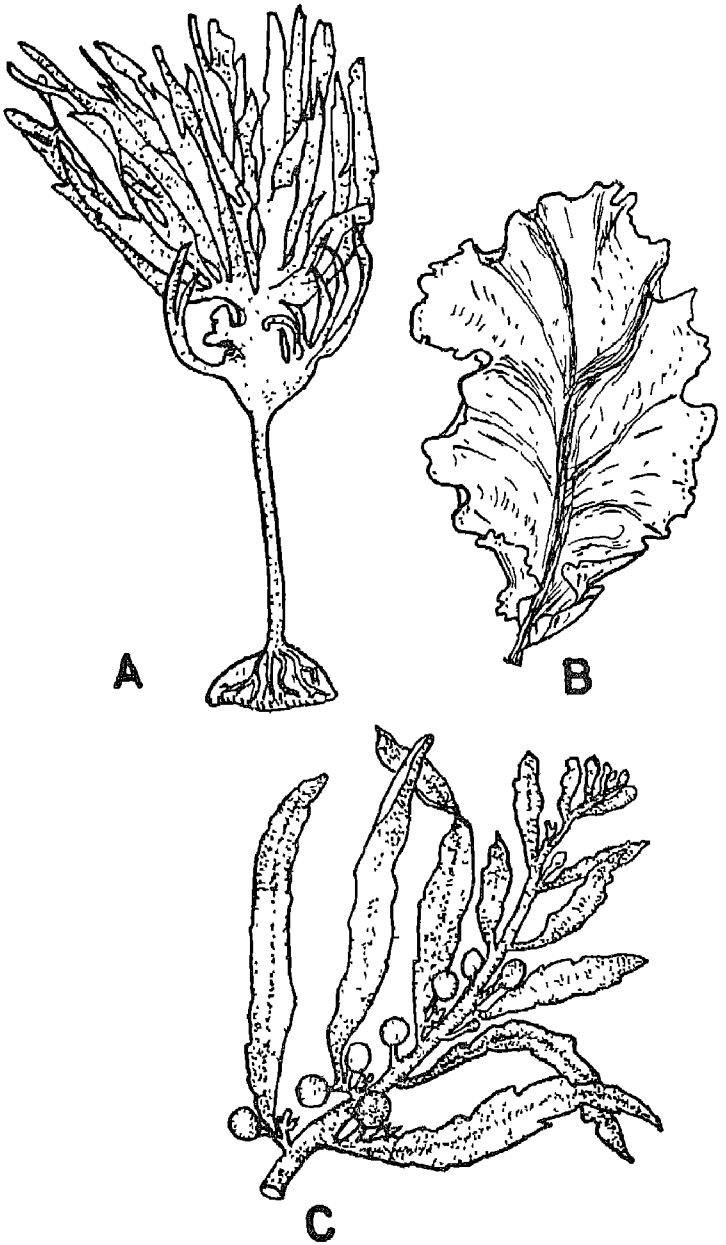

Fig 1.8. Some sea weeds. A, *Laminaria*; B. *Ulva*; C. *Sargassum*

The body structure is more complicated than in bacteria. They differ from the flowering plants in having no root, stem, leaf, flower, fruit or seed. The algae are very useful as producers of oxygen and as food for fishes, men and other animals. They are also used in fertilizers. We obtain iodine from some of them. Some can fix atmospheric nitrogen.

Questions

1. Where do you find algae ?
2. Give the structure of a *Chlamydomonas* cell ?
3. What is the green colour of algae due to ?
   What is its function ?
4. How are the algae useful to man ?
5. Describe a green filamentous algae ?

Tasks

1. Visit the local pond. Collect the green 'scum' from the surface of the pond. Examine it under the microscope and draw sketches of the green plants that you see.
2. Put some pond water with some *Spirogyra* (fresh and green) in a glass jar and put it in the sunlight. Observe bubbles of oxygen coming out.

§ 3. FUNGI

In the rainy season, if you go to some open fields you might observe some soft, white or cream-coloured umbrella like structures growing on the ground. What are these ? These are some living organisms. Are these plants ? These are mushrooms and toadstools which are also plants. You might have also seen some cobweb-like structures growing on stale bread. After sometime this cobweb may be covered by black spots. On wet shoes and leather also you might find some blue or greenish white patches of fluffy growths. These are all called **moulds**. The moulds as well as the toadstools and mushrooms belong to the group of plants called **fungi**. These plants do not have chlorophyll and cannot make their own food.

Let us see how they get their food and grow ? Observe that the moulds grow on bread, on decaying food and on leather. Mushrooms grow on dead animal or plant bodies or decaying wood or on dung heaps. They get their food from the substances on which they grow. When the fungi grow on dead organic matter such as plant or animal remains, food, leather etc., they are said to be **saprophytes.** Sometimes like bacteria, fungi also grow on living plants and animals obtaining prepared food from these hosts. They are then said to be **parasites.**

Moulds

You can very easily grow moulds in a classroom. Take five glass dishes, put some filter paper soaked in water in each one of them. Mark them 1,2,3,4 and 5. Put a slice of cheese, a slice of banana, a piece of leather, a piece of bread or a spoon full of jam one in each dish. Put all these dishes in a dark warm corner of your laboratory. Take care to keep them moist all the time. After some days you may notice some bad smell coming out of them. After a few days some white cotton-like mass will appear on them. Observe the colour of these new growths. These may be green, yellow, black or blue. What are these ? These are called the moulds.

Put a pinch of these growths on a slide. Add a drop of water. Separate the threads and see them under the microscope. You will see some fine thread-like structures, which are colourless. These are the the threads of the bread mould—*Mucor* (Fig. 1.9). The threads appear to be filamentous. They have no cross walls. Inside, there is cytoplasm and a large number of nuclei. Carefully examine the filaments. Some of them have dark-coloured structures at their tips. You will find a number of globular structures at the end of short filaments. These are sporangia. A few of them will be found to have burst open and thrown out extremely small structures. These are **spores.** In dry conditions they are carried away by wind. Falling on suitable ground they germinate and grow into new

fungus filaments. The fungus reproduces by spores.

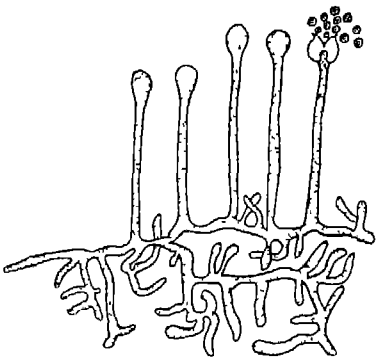

Fig. 1 9 *Mucor* · bread mould

Apart from *Mucor*, in your culture you will get a number of other moulds. Among them the most important is the blue-green mould. This is *Penicillum*.

It is a very useful and important mould. You have heard of doctors giving penicillin injections to people suffering from fever and cold. The drug penicillin is obtained from this blue-green mould *Penicillum*. It is very useful in fighting bacteria that cause diseases in us. Because of this property penicillin is called an antibiotic. The action of penicillin was first discovered by chance. One day when Alexander Fleming was working in his laboratory he found that one of his culture plates containing a harmful bacterial colony was contaminted. On examination he found some patches of the mould growing in the bacterial culture. Curious as scientists are, he did not throw away this culture but started studying this new growth. He was surprised to find that this new growth destroyed the original bacterial culture. This was an astonishing and momentous discovery. The mould was identified as *Penicillium*. Later other scientists extracted the penicillin from this mould. Now penicillin is being widely used by doctors in treating patients for various bacterial diseases. There is a big antibiotic

factory at Pimpri near Poona to manufacture penicillin. Discovery of penicillin was of great importance. It has saved millions of people from death due to septic wound, pneumonia and many other diseases.

The plant body of *Penicillium* is thread-like. This thread is divided into small chambers by transvers partition walls. Each chamber contains a nucleus. It reproduces by means of spores. Spores are produced in finger-like structures which are clustered like a broom. This method is called asexual method (Fig. 1.10). It also reproduces by sexual method.

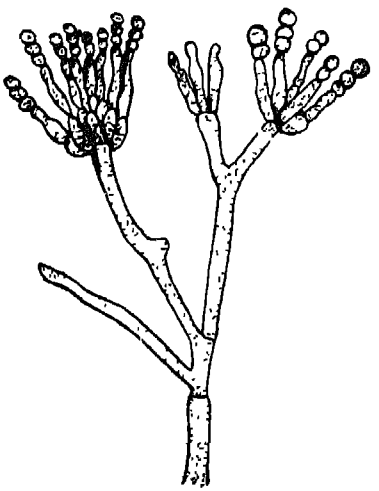

Fig.1.10, *Penicillium* . A fungus from which the drug penicillin is extracted

Mushrooms

During the rainy season you may have seen lots of mushrooms or toadstools growing on the open fields. Mushrooms also grow on dung-heaps and on decaying woods or logs. They are found in moist warm and shady places. The mushroom has a long stalk known as the **stipe**. On top of this is a cap-like structure (Fig. 1.11). This is the fruiting body of the fungus. On the under surface of this cap are a number

of radiating membranes. These membranes bear spores on either side. Cut the cap of the mushroom and keep it on a white sheet of paper and then cover it with a glass jar. After sometime take off the jar and the cap. You will be able to see that the spores have fallen in radiating rows on the white sheet

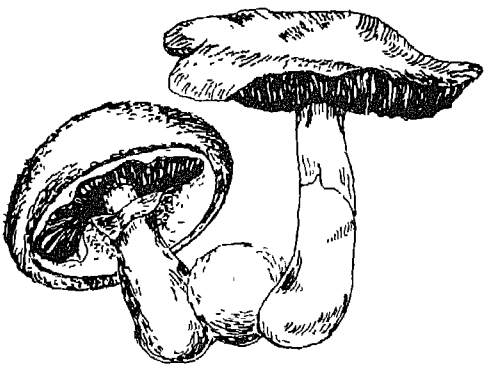

Fig 1 11. Mushroom A common fungus found during rainy season

of paper. These radiating rows will correspond to the radiating membranes of the cap.

The soft stalk and the cap-like structure are not the whole plant. Beneath the soil there are thread-like hyphae of the plant body known as **mycelium**. From this network the mushroom starts first as a button-like structure and then grows into the familiar plant body.

Some mushrooms are eaten. Many are also poisonous. One has to be very careful in selecting the edible ones.

Some other fungi are parasites. They live in the bodies of living animals and plants and cause diseases. Certain parasitic fungi cause diseases of cereal crops, vegetable and useful plants. Chief among them are rust and smut diseases of wheat, bunt of rice, red rot of sugarcane, potato blight and many others.

Rust

The rust disease is of great importance to us. This disease

causes great damage to our wheat crop. In the diseas condition the leaves of the wheat plants are covered by brow. spots (Fig. 1.12). These spots form spores which are dispers by wind.

The streaks or spots look like iron rust and hence th name rust disease. The leaves get spoiled by the disease an

Fig. 1.12. Rust on wheat plant: A disease caused by a fungus. The plant shows the symptoms

cannot manufacture their food. Without food the plant does not yield enough and healthy grains. The smut and the rust diseases can be controlled by spraying the fields with fungicides, disinfecting the seeds or by breeding resistant varieties.

Importance of Fungi

The fungi as a group is of great significance to mankind. Like bacteria they are both useful as well as harmful to us. Many of them cause diseases of the crop and inflict heavy damage. Edible things are spoiled by them when left neglec-

ted. Some fungi called the bracket fungi damage the timber producing plant.

Not all fungi are harmful. Some fungi such as yeast are useful in the wine industries and bakeries. They help in the rising of the dough. Some of them produce antibiotics. Most common and important antibiotic is penicillin. Others, such as streptomycin, aureomycin, terramycin are all produced from fungi-like organisms. These antibiotics are very useful in fighting diseases and in saving the lives of millions of people. There are still other fungi which form the food of man, such as mushrooms. Thus we see that this group of plants is of great significance to man.

Questions

1. Where do you come across mushrooms ? What do they look like ? What are their uses ?
2. How do fungi harm us ?
3. What are moulds ? Describe the structure and reproduction of bread mould.

Tasks

1. Collect mushrooms from the fields and bring them to the classroom. Study and draw the picture of a mushroom.
2. In the laboratory grow some moulds and study them. Draw the picture of each type of mould after examining them under microscope.

§ 4. LICHENS

Walking along a road on any hill station you may find some 'mossy' growth hanging from the branches of trees or some greyish green patches growing on rocks or even on tree trunks. Scrape a little of this with your penknife and see what they look like. They are flat and foliose. They seem to grow

even without any moisture. Let us take a section of this foliose piece and see what its structure is like. What do you see? Some fine and colourless filaments are seen interwoven with each other. In between these filaments are some green coloured cells. They are more towards the upper side. These green cells look like algal cells and the colourless filaments look like hyphae of fungi. These strange plants seem to be associations of fungi and algae. They are called *lichens*.

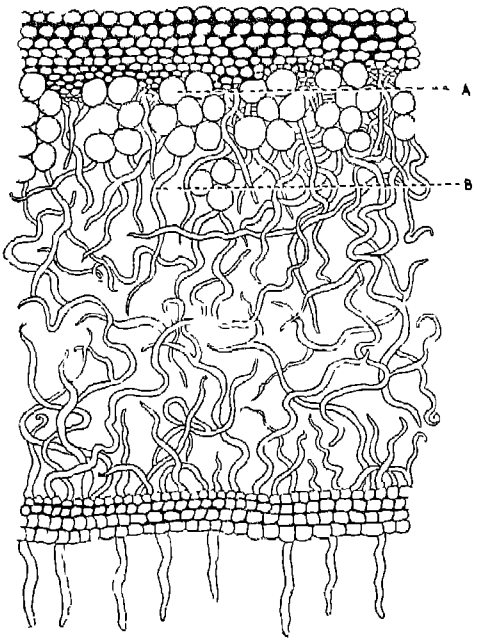

Fig.1.13. T S. of a lichen thallus

Occurrence

Lichens occur in the most unexpected and inhospitable places. They may be found as crusts on bare rocks. Lichens may thrive in very hardy situations. In the forest they may cover the bark of the lower branches. They may be leaf like and form a rosette or crust (Fig. 1.14). They may also hang like strands. In some places like the cold plains of Siberia there is

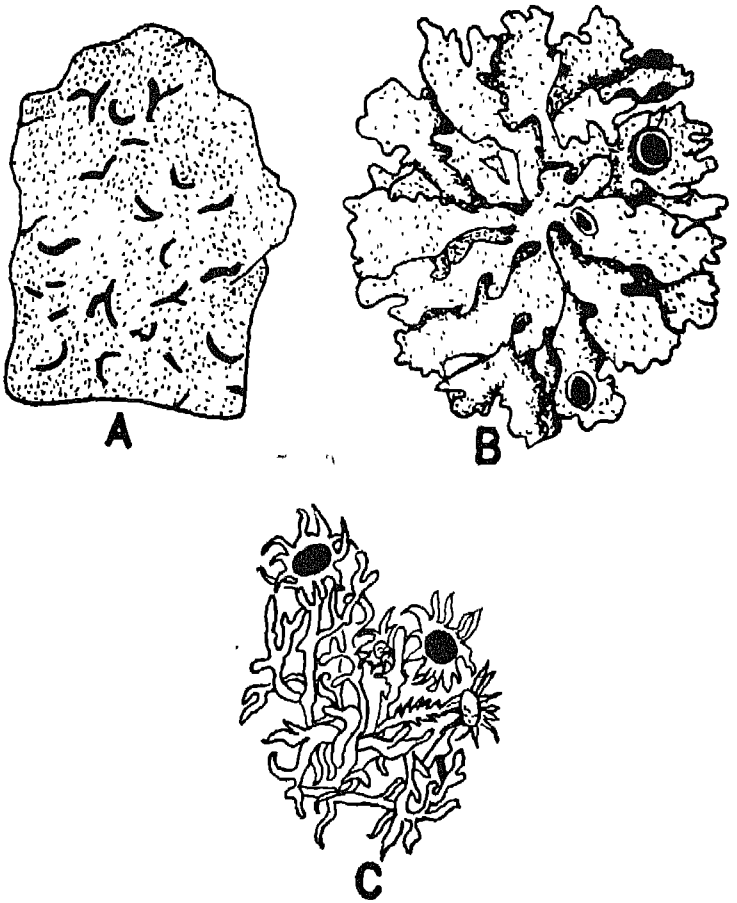

Fig. 1.14. Types of lichens . A. Crustose; B. Foliose; C. Fruticose

no other vegetation except lichen which is known as 'reindeer moss'. 'Reindeer moss' forms the food of reindeers.

Structure and Nutrition in Lichens

We have already seen a section of the plant body of lichen. It consists of colourless fungal threads and green algal cells. The fungi as you know cannot make their own food. How do they then survive and grow ? The green algal cells present in the lichen contain chlorophyll and can manufacture their own

food. These cells take carbon dioxide from the air and with the help of sunlight, chlorophyll and water they can prepare sugar. But how do these isolated cells get water ? There is a strange relationship. The algae get shelter and moisture from the fungal filaments. The hyphae of the fungal filament in turn absorb sugar from the algal cells and use it for their growth. Thus there is a mutual give and take between the algae and fungi in this plant body. Such a relationship is called **symbiosis.**

Significance of Lichens

Lichens are able to grow anywhere as their requirements are few and they are very hardy. They are almost the pioneers in almost any barren place. When their plant bodies die and decay, they with some dust and mud form good soil for other plants to grow. In places in the arctic zone where there is no other vegetation 'reindeer moss' is used as food for the reindeers.

Questions

1. Where do lichens grow ?
2. If you cut a thin section of a lichen plant body, what structures will you see ?
3. What is symbiosis ?
4. What is the importance of lichens ?

Tasks

Make herbarium specimens of different types of lichens and study them. Draw them in your note-book.

§ 5. BRYOPHYTA

Mosses are very common during the rainy season. Take a careful look at these mosses. Generally any small green patch of plants, growing on wet walls, rocks or on the sloping banks of rivers or pools is termed as 'moss'. All these are not the true mosses. You may pick up one moss plant out of these growths.

The moss looks like a plant on a miniature scale. It has tiny leaves and small soft stems. A single plant cannot stand erect. As they grow in a bunch they support each other. They grow only in moist places. There are other types of plants which also belong to this group and which have lobe-like appearance. They are called **liverworts**. Both liverworts and mosses belong to the group **Bryophyta.**

Structure of Moss Plant

Take a moss plant in a watch glass and examine it with a lens. You will find small, thin leaves attached to a central stem-like portion. Remove a leaf and place it on a slide in a drop of water; cover it with a cover-glass and examine it under a microscope. The leaf is found to be made up of a number of cells. Each cell has a number of chloroplasts. These are not true leaves. Hence we say the moss has 'leaf like' and 'stem-like' structure.

Let us look at a thin section of the stem in a cross section. The cells in the centre are smaller and have slightly thicker walls, but we do not find any xylem cells as we find in the vascular bundles of the flowering plants. The whole moss plant is attached to the soil by means of hair-like structures. These are called **rhizoids.** There are no true roots in moss plants.

Reproduction

How do the moss plants reproduce ? If you notice a cluster of moss plants you will see some of them have a long stalk at their tips with a swollen structure at its end (Fig. 1.15). These are called moss **capsules.** Take a capsule and place it on a glass slide. Try to remove the top. It comes off as a cap. Squeeze the capsule. Some small structures come out. Each of this is a spore. When conditions are favourable the spores germinate to put out green filaments which bear buds from which moss plants grow. In dry weather many capsules let out dry spores which are carried away by wind. When they fall on a new suitable place, the spores germinate and form moss plants.

The moss plants have no flowers and they do not produce any fruit. A few plants produce special structures called **antheridia** at their tips and others produce another type called **archegonia**. The former are male reproductive structures which produce sperms. The latter are female reproductive structures and they form eggs. In moist weather the sperms are liberated, they enter the archegonia and fuse with the eggs. The fertilized egg gives rise to the capsule. The capsule remains attached to the moss plant from which it gets all its food.

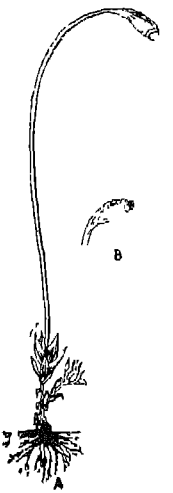

Fig. 1.15. A *Funaria* A. moss with the capsule ; B. A capsule which has burst

The moss plant is more complicated than an alga or a fungus. Mosses differ from flowering plants in not having true stems, roots and leaves. They do not have flowers and do not bear seeds.

Significance of Mosses

Mosses can grow in places where there is very little soil. In a way they are also pioneers like the lichens. Mosses are not very useful to us. In Europe and temperate countries mosses grow in plenty. When dry they are used as fuel. This is called peat.

SUMMARY

Bryophytes are very simple green land plants. They differ from the flowering plants in having no true stems, leaves and roots and do not bear flowers, fruits and seeds. They have rhizoids for the absorption of water and mineral salts from the ground. They reproduce by means of spores. They form one of the pioneer plants for inhabiting any barren land. In the form of peat the moss is used as fuel in some countries.

Questions

1. Where can you find a moss plant ? How do they reproduce ?
2. How do bryophytes differ from the algae ? How do they differ from the flowering plants ?

Task

Collect some moss plant and examine them by means of hand lens. Make a sketch of the plant along with the capsule.

§ 6. PTERIDOPHYTA

In the garden some plants are grown for their beautiful foliage. Among them you will see the ferns. They have beautifully shaped, delicately designed green leaves. Ferns also grow in forests and on cliffs of hills where the weather is cooler. The ferns belong to a group called **Pteridophyta**.

The Fern

The ferns are the most common pteridophytes. No green house is complete without some collection of ferns adding to its beauty. Ferns may be of many different types, such as the maiden-hair fern (*Adiantum*) with its beautiful dark leaf-stalk which can easily be compared with the jet-black locks of girls. It is from this resemblance that it got its name. There are other ferns like *Pteris* and *Polypodium*.

The fern plant has root, stem and leaves much like the flowering plants you have already studied (Fig 1.16). The stem of fern is usually present below the surface of the soil. This type of stem is known as a **rhizome**. From the rhizome arise the roots. Roots absorb mineral salts and water from the

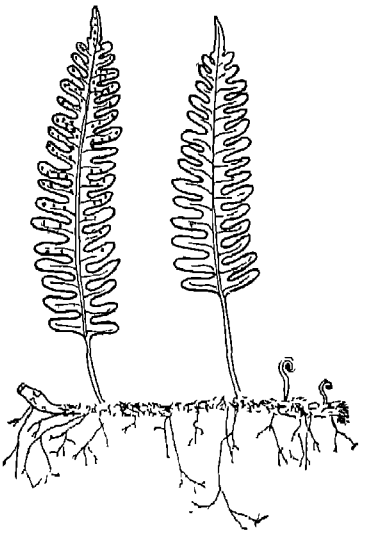

Fig. 1.16. Fern

soil. From the upper side of the rhizome arise leaves. The leaf is divided into leaflets. It is this division and symmetry that gives beauty to a fern leaf, which is also called a frond. Food is prepared as usual by the green leaves. The leaves have cells which have green chloroplasts.

The leaves have another very important function. The

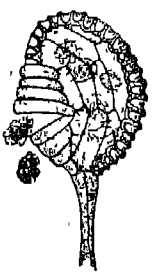

Fig. 1.17. Sporangium of fern

older leaves bear brown spots on the under surface. If you examine these spots with hand lens, you will see some brown structures. These are called **sori.** Each sorus consists of a number of box-like structures each with a stalk. Each of this is a **sporangium.** Inside each sporangium is produced a large number of spores (Fig. 1.17). When the sporangium is ripe it opens and the spores are shed. Each spore germinates to form a green heart-shaped structure. This structure bears the sex organs. After fertilization of the egg and formation of the zygote a new fern plant is formed.

The Horse-tails and Club-mosses

Besides the ferns, the pteridophytes include other ferns. Two such are the horse-tails (*Equisetum*, Fig. 1.18) and the club-

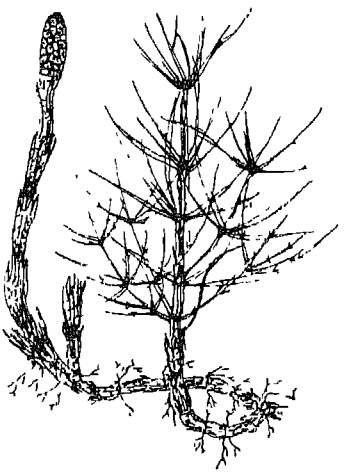

Fig. 1 18. *Equisetum* or 'horse-tail', a pteridophyte

mosses (*Lycopodium*, Fig. 1.19). They get their strange names from the shape of the tip of their branches which bear sporangia. Unlike the ferns, the horse-tails and club-mosses do not have large leaves. Their leaves are very much reduced and the stem in horse-tail is green. These plants also reproduce by means of spores. The ferns, hores-tails and club-mosses resemble each other in having roots, stems and leaves. The

roots, the stems and the leaves have special tissues for conducting water, minerals and food, which are known as xylem and phloem. These constitute the vascular tissues.

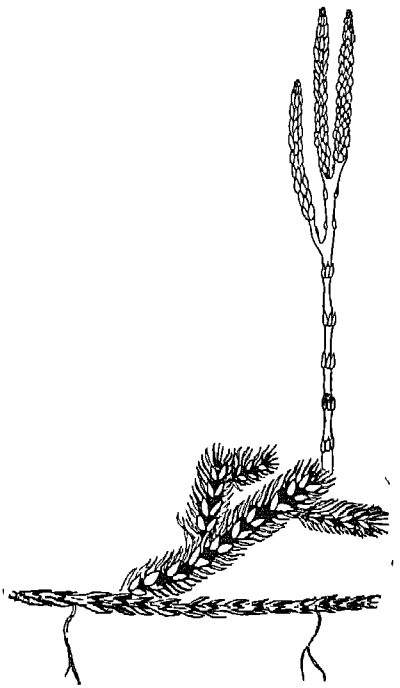

Fig. 1.19. *Lycopodium* or 'club-moss'. a pteridophyte

Importance of Pteridophytes

The ferns of today are not very useful. They are used only as ornamental plants. The pteridophytes grew as thick forests on earth some millions of years ago. These forests had giant trees such as horse-tails and club-mosses unlike the ones found at the present day, and they were mainly growing on swamps. (Fig. 1.20) Due to certain climatic changes whole forests got buried under the earth. High pressure and other factors changed gradually the wood and other remains into coal. It is this coal we are now mining. Coal is used in industry and transport. Many important chemical products are obtained

from the coal. Among the deposits of coal sometimes beautifully preserved specimens of plant remains are found. These are called 'fossils'. Study of fossils is very important to a biologist. The period in which the pteridophyes flourished as dense forests is known as the coal-age.

Fig. 1 20. some fossil pteridophytes

SUMMARY

Pteridophytes are the most primitive among the plants possessing vascular tissues. They are the earliest plants having vascular tissues. These plants reproduce by spores. Once the pteridophytes were the most widely distributed plants on earth. During the coal age they grew as dense forests of huge trees. These forests are now preserved as coal beds in the interior of the earth. Coal is very useful in our industry.

Questions

1. Where do you find ferns in nature ? How do they resemble a flowering plant and a moss ?

2. How does a fern plant reproduce ? How is it different from that of a flowering plant ?
3. In what ways are the ancient pteridophytes important to us.

Tasks

1. Collect some fern plant and make herbarium specimen.
2. Collect different types of fern leaves with sori on the under surface. Mount them on the herbarium sheet so that the sori are visible.

§ 7. GYMNOSPERMS

In any hill station you may come across some trees which look different from the usual flowering trees of the plains They are tall and often bear woody cone-like structures. The common pine tree belongs to this group. They neither bear flowers as you know them nor do they produce fruits. Their seeds are formed in the axils of the scales which are present in the cone-like structures. These seeds are not covered by a fruit wall as in bean, pea or any other flowering plant but are exposed. Hence the seeds are said to be naked. These plants are called gymnosperms because their seeds are naked. *Gymno* means naked, and *spermae* means seeds. Angiosperms and gymnosperms both produce seeds and so these two groups are together called the 'seed-plants' or plants which produce seeds. The difference between angiosperms and gymnosperms is that in angiosperms the seeds are always covered by fruit walls while in gymnosperms there is no fruit-wall. The seeds are naked and exposed. Gymnosperms are found mostly in cold and temperate regions. *Cycas* and *Araucaria*, the ornamental garden plants, are gymnosperms. These may be seen growing in gardens even in the plains. Some species of *Cycas* also grow wild.

Let us study the features of a pine tree to know more about this group of plants.

The Pine Tree

The pine tree generally grows on hills and in cold places. It is a tall evergreen tree with needle-shaped leaves. These are

often called pine needles. If it is a fairly well-grown tree we may even see hard woody cones (Fig. 1.21).

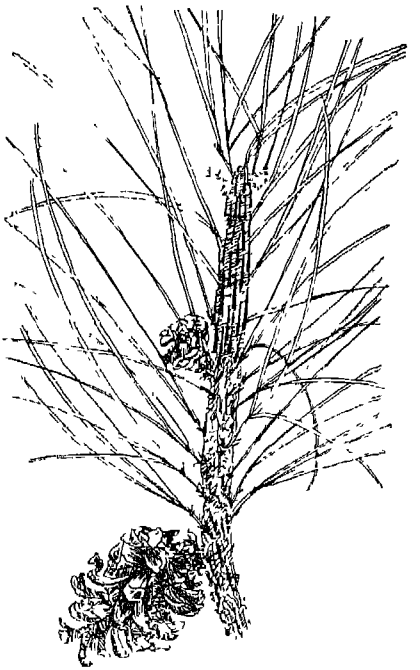

Fig. 1 21. Pine: twig of the pine tree

The pine tree grows to a height of about 30 metres. When grown in the open it bears many branches. However, in a dense forest the tree often has a conical appearance. There is a thick strong stem with no branches up to a certain height after which the branches are given off.

The needle-shaped leaves are in bunches of three to five. They are green and have chloroplasts in their cells. The shape of the leaf enables the plant to prevent excessive water loss by transpiration. This is very helpful to the plant because in places where the pine tree grows the water supply is not continuous.

The pine tree bears two types of cones. The smaller cones, which are borne in clusters are the male cones (Fig. 1.22). The

male cone bears the pollen sacs which produce a large amount of pollen grains. Often in a pine forest the floor is covered with yellow dust. Sometimes the pollen grains rise up in the cloud and when it rains, they come down as 'yellow rain' or 'sulphur showers'. The pollen grains are winged and thus can be carried away to long distances by wind. The pine tree is wind pollinated.

There is another type of cones which are borne singly and are woody. The woody cones that you generally see on the pine tree or on the floor of the pine forest are the old female cones (Fig. 1.22). The female cone bears the scales. These scales

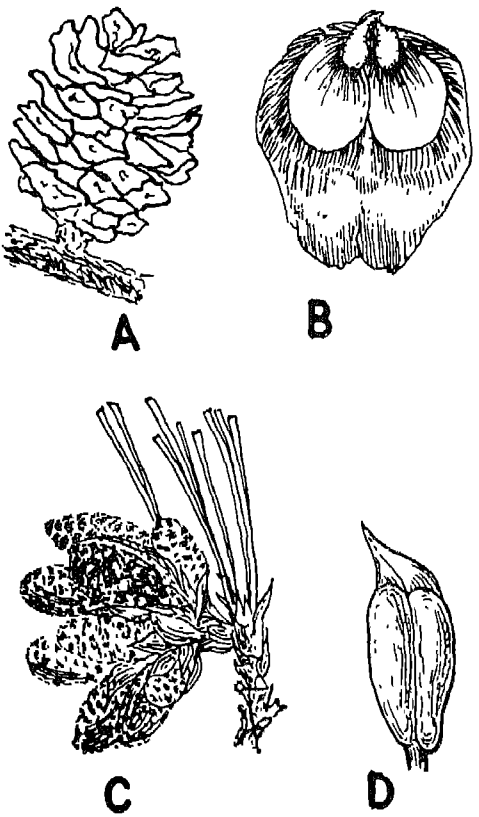

Fig. 1.22. A. Female cone, B. Megasporophyll, C Male cone; D. Microsporophyll

bear ovules on their upper surface. There is no pistil. The wind carries the pollen grains to the ovules. Fertilization takes place and then the seeds are produced. The seeds are not enclosed but lie naked Each seed has a wing and can fly to a long distance.

Uses of Gymnosperms

This group of plant is of great importance to mankind. The wood of some gymnosperms such as pine and cedar are used in the construction of buildings and for making furniture. Turpentine oil is obtained from the wood of certain species of pine. Tannin and resins are other products obtained from pines. Some gymnosperms are grown in gardens as ornamental plants. These are *Thuja*, *Cupressus*, *Araucaria* and *Cycas*. 'Sago' is obtained from the stem and seeds of some species of *Cycas*.

SUMMARY

Gymnosperms are seed-bearing plants. The seeds are not enclosed by fruit walls. They are generally borne on woody cones. They usually grow in cold regions. Pine tree has needle-shaped leaves which help the plant to prevent excessive transpiration.

Questions

1. What are the main characteristics of gymnosperms ? How do they differ from flowering plants ?
2. Describe the parts of a pine tree. How are gymnosperms useful to us ?

Task

Bring a twig of a pine tree with cones to the classroom. Observe the parts and make drawings of it.

§ 8. ANGIOSPERMS

By now you have learnt about different kinds of plants. Starting from the tiny bacteria to the huge trees, there are

various varieties of plants. The great majority of plants that we see around us are flowering plants. They belong to the group **angiosperms.** They are found everywhere in the world and in all climates from the hottest desert to the coldest places. They have been able to spread and dominate over all the other plant groups. The flowering plants have many advantages over the other land plants such as pteridophytes and gymnosperms.

The flowering plants as the name suggests bear flowers. They differ from gymnosperms in that they have the ovules covered in a structure called the ovary. The ovary is a part of the pistil. The ovary wall after fertilization develops into the fruit walls. Thus the seeds are enclosed in fruit. This group of plants which has the ovules covered within the walls of the ovary is called angiosperms (*Angio*=covered, *spermae*=seeds).

Angiosperms have many types of plants. Most of these plants are very useful to man. You have studied about their ways of life and the families of some important plants in the previous chapters.

The flowers may have beautiful bright colours, pleasing scent and sweet nectar. Pollination in angiosperms is brought about by wind, insects and other agencies. Insects visit the flower in search of nectar and in this process carry pollen grains from one flower to the stigma of another. That is how pollination takes place. After pollination and fertilization the ovary becomes big, sometimes fleshy. The ovules inside the ovary develop into seeds and the ovary into the fruit. The method of dispersal of seeds in angiosperms is very effective so that they can be spread to great distances. Many agencies bring about the dispersal such as wind, water, insects, birds, animals and many others. The flower and the fruit are new structures you find in angiosperms which you do not see in any other group of plants.

SUMMARY

Angiosperms are the highest evolved plants. They differ from other groups of the plant kingdom in possessing an

ovary inside which are borne the ovules. They also produce fruits. Angiosperms are of great economic importance.

Questions

1. What are the chief characteristics of angiosperms? How do they differ from other groups of plants?
2. What is the reason for the wide distribution of the angiosperms?
3. What is the economic importance of angiosperms?

CHAPTER II

Introduction to Animal Life

Diversity of Animal Life

Plants and animals make up the world of living things. Just as the many kinds of plants form the plant kingdom, the animals form the animal kingdom. If you sit calmly and recollect the various kinds of animals you have seen, you might find that you know a large number of them. Some people think that only such large beasts like elephants, tigers, cows and horses are animals. Earthworms, ants, bees, butterflies, spiders, snails, fishes, frogs and crows are also animals. There are again very minute animals like *Amoeba* and *Paramecium* that are made up of single cells and can be seen only with the aid of magnifying devices.

How are these animals different from one another? Animals differ in their sizes, in the nature of their organs and consequently in the nature of their way of life. Animals are found in different surroundings. There are animals on mountains, on land, under the surface of the soil, in the upper layers of the sea, in the deep bottoms of oceans, in rivers, ponds and even in snow. To successfully live in any surrounding the animals should have suitable body features. Animals with such body features suitable for living in that surrounding are said to be adapted for living in that particular surrounding. Thus animals living in water are almost devoid of hairs, since hairs might stand in the way of their quick movements. The aquatic animals have fins, and similar structures useful for locomotion. Adaptations to the different food habits of animals are well seen in the structure of the tooth and legs of animals. Animals eating flesh have sharp cutting teeth and claws in their feet, while animals that feed on plants have grinding teeth. How did these varieties of animals originate in

the animal kingdom? It has been found out that animals go on changing their structures. This change has gradually brought the animals to the present forms. Different animals might change in different directions. How do we know that animals have changed? Scientists have discovered the remains of animals of the past. Many of these appear like stones with impressions of the animals or their parts. Sometimes scientists found tracts of animals of the past or whole animals fully trapped in resins or buried in ice. The animals of the past or their parts or the cast or impression left by them are all called fossils. A large number of fossils recovered from different parts of the world gives us an idea of the nature of the animals and their life in the past. Many of the animals found today were not found in the past. Likewise many animals found in the past are not found today. Some of the animals that are found today are very much different in appearance and size from those that were found in the past. These facts indicate that animals change in course of time. Such changes are very slow and have taken many millions of years.

Importance of Animals

Animals are useful to man in different ways. The products of certain animals are taken as food by man. These food materials may be milk and its products, mutton, pork, eggs, fish and its products, and honey.

Leather and its products are obtained from the skin of animals. Leather is useful for making shoes, boxes, bags and certain kinds of dresses. Silk yarns useful for making silk cloth are obtained from the cocoons of silk moths. Lac, a secretion from certain insects, is used for manufacturing shellac and some paints.

Other miscellaneous objects obtained from animals are : pearls from pearl oysters ; bees wax from honey comb ; buttons from the shells of clams ; lime from clams and mussels and coral rocks.

Apart from yielding products animals are useful to man

in agricultural operations and in transport. Animals like butterflies, moths, bees, birds and bats pollinate flowers in nature. As a result of pollination, the plants yield products which are useful to man in many ways. Many birds feed on harmful insects and this keeps down the agricultural pests.

Animal products such as bones and blood are used to make some organic fertilizers. Similarly fish meal is also used for agricultural purposes.

Interdependence of Plants and Animals

Plants and animals form the two categories of living things. Plants and animals are mutually dependent. You have seen butterflies and bees frequently visiting flowers. You know that both plants and these animals are mutually benefitted by these visits. The bees get pollen and nectar as their food from the flowers. The plants in their turn get pollinated by pollen grains carried by the animals during their visits from flower to flower. You are also familiar with another but similar relationship between plants and animals. Plants produce seeds inside their fruits. The seeds must be distributed far from the mother plants. Many animals help in carrying the seeds. Some of these animals eat the fruits and help in the dispersal of seeds. Wading birds have been known to carry several seeds unwittingly in their feet for long distances.

You have learnt in the previous class that green plants are primary producers. All animals either directly or indirectly depend upon plants for their food. The excreta of animals, after decomposition, are taken up by plants and utilized as nutrients useful in manufacturing food.

SCOPE OF THE SCIENCE OF ZOOLOGY

The study of animals and their lives is called zoology. In zoology, different aspects of the life of animals are studied. Some examples of such studies are : the various parts of the body of animals and their functions ; the life of the animals in

relation to their surroundings, the various changes that take place in animals as they grow from their embryo stage to the adult stage, and the way animals inherit parental characteristics.

Why does man study the various aspects of animals ? The study of the heredity of animals, for example, helps man to obtain better varieties of domestic animals like cows, bulls, pigs, sheep and fowl. These better varieties of animals either yield greater quantity and better quality of products like milk, meat, wool and eggs or can work harder in agricultural fields or as draught animals. The study of the insects gives us valuable information about their life which is useful in finding out means of controlling harmful insects and increasing the number of useful insects. The useful insects yield various products for the benefit of man like honey, beeswax, lac and silk. The study of the life of fishes helps man in increasing fish production. Thus the study of zoology benefits man in many ways.

Need for Conservation of Animals

Have you visited either a zoo or a circus ? There you might have seen different kinds of wild animals. These wild animals like lions, tigers, bears, bisons rhinoceros and elephants live in forest. Some men go to the forests to hunt these animals for their beautiful skin or the flesh or for sport. If large numbers of such men hunt these animals their number would soon be reduced. Sometime back it was found that the lions founds in certain forests in Gujarat state were very much reduced in their numbers. If in such conditions man continued to hunt lions, one day no lions will be found in India. It was again recently found that a large number of rhinoceros were killed in the jungles of Assam with the result that rhinoceros have become very scarce. Our wild animals should not be allowed to vanish. Therefore, the government has prohibited the shooting of certain animals in certain forests.

You might wonder why we should protect certain dangerous animals like tigers, lions and leopards that hunt and kill other

animals like deer. You should know that in forests, if man does not interfere with the animals living there, the numbers of plant-eating and flesh-eating animals remain more or less constant, year after year. This is called the 'balance of nature'. If man, for example, kills a large number of flesh-eating animal like lions, tigers etc, in a forest, their numbers will be reduced. Since there will be lesser number of flesh-eating animals, the plant-eating animals like deer, will increase in number. Then the forests will be full of these animals. There might not be enough food for these plant-eating animals in the forest. Therefore these animals might start eating every bark, twig and leaf they find. Thus the valuable plant life of our forests might be destroyed. Very often the flesh-eating animals succeed in killing animals that are easily caught by them. Such easily caught animals are usually weak and sick animals. Thus the flesh-eating animals help in a way to remove the weak and sick animals in the forests. If we destroy a large number of plant-eating animals in the forests, there will be lesser number of these animals available as food for the flesh-eating animals. The flesh-eating wild animals might move away from the forests and start attacking cattle and men from the villages that are near the forests.

Our wealth of wild animals includes many kinds of mammals, birds and fishes. There is no harm in killing some of them for our use. But we should not indulge in killing large numbers of any kind of wild animal to the extent of making it completely disappear from our land. In the real sense, conservation means not only protecting wild animals but also obtaining the maximum number of animals for our use without upsetting the 'balance of nature'.

Questions

1. (*a*) What is adaptation ? What does this term mean ?
   (*b*) How is the fish adapted for living in water ?
2. Name the various useful products obtained from animals.

3. Describe with examples the instances in which you have observed animals helping plants.
4. How does the study of the life of animals help mankind ?
5. (*a*) What is meant by conservation ?
   (*b*) How can the government help in the conservation of animals ?
6. (*a*) What is 'Balance of Nature' ?
   (*b*) Can the destruction of all trees in a forest upset the life of animals in it ? If not, why not ? If so how ?

Tasks

1. Visit a nearby bird sanctuary.
2. Collect and display some useful products of animals.
3. Read books on our wild life.

CHAPTER III

Protozoa

While studying the different groups of plants, we learnt about algae which usually are found living in ponds, tanks and ditches as green scum. The algae belong to the simpler groups of plants. Collect some samples of water from similar ponds in which green scum and plenty of decaying leaves are found. Examine a drop of this water under a microscope. You may find small little things moving actively or slowly in the drop. Some of them may be simple plants. Others are moving about, usually colourless and variously shaped. These belong to a very primitive group of animals called **Protozoa**. These animals are very simple in form and structure. Protozoa is a name which means 'first animals'. We shall study about two of these animals in this chapter.

AMOEBA

When you are examining a drop of pond water, as described earlier, you are most likely to observe a small little thing which has an irregular outline and which moves about slowly.

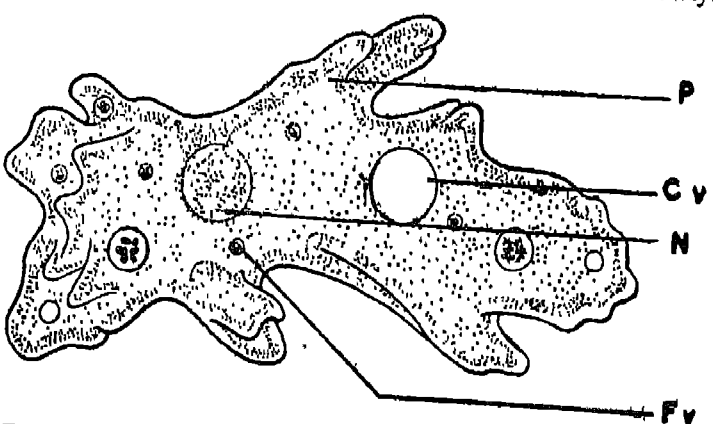

Fig. 3.1. Amoeba . P. Protoplasm; FV. Food vacuole; CV. Contractile vacuole; N. Nucleus

This simple animal is called *Amoeba* (Fig. 3.1). It has only one cell in the body and hence it is a single-celled animal. The body has a little mass of protoplasm. Look carefully to see whether there is anything else. The protoplasm looks granular. There is a central spherical structure called the nucleus. The body has no definite shape. The shape seems to change constantly, and as it changes these animals slowly move. The body has a number of projections which also change their shapes. These projections are called **pseudopodia** (false feet).

Movement in Amoeba

Through a lens or the low power of a microscope observe an *Amoeba* and see how it moves. One of the projections slowly becomes long and some material of the body (protoplasm) moves into it. Soon another projection is put out. With the help of these pseudopodia the animal moves in an irregular way. As it moves some pseudopodia are drawn into the body. Though irregular in shape the whole body is covered by a cell membrane.

Nutrition

Watch an animal closely and see how it feeds. The animal feeds on algae or bacteria or other small organisms or organic matter. The method of feeding is very simple. When this *Amoeba* comes in contact with an alga or food particle it starts sending out a pseudopodium around it. Gradually the plant cell or food particle is surrounded by the pseudopodium. Ultimately the food is engulfed inside the body of the animal along with a droplet of water. The food and the water droplet together become a vacuole. This is called a **food vacuole** (Fig. 3.2).

The food is very soon digested by the action of some enzymes which enter the vacuole from the cytoplasm. The food when digested dissolves and is absorbed by the cytoplasm. Enzymes are organic substances formed in a cell which help to break down complex substances into simpler substances.

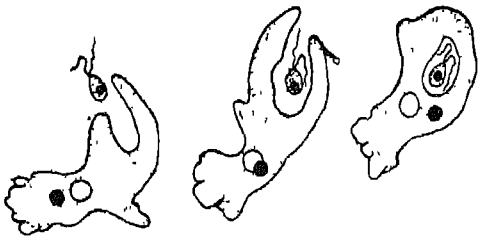

Fig. 3.2. Nutrition in *Amoeba*

Enzymes take part in many life activities. Digestion is one such. The undigested portion of the food is thrown out of the body. The food vacuole gradually comes to one end. It then opens out and the remnants of food are thrown away. The body closes up and the *Amoeba* moves on. This throwing away of the food particle can take place at any point of the body.

Respiration and Excretion

We have already seen how the different plant organs respire. All living things respire. *Ameoba* also respires. It takes in oxygen and gives off carbon dioxide. The oxygen is used to break down food substances. Some energy is released in this process and carbon dioxide is given off. The energy released is used in other activities.

The exchange of gases, that is diffusion of oxygen into the body and that of carbon dioxide outside, takes place through the surface of the body of the animal.

Examine the body of *Amoeba* carefully. You will see that a small vacuole-like structure becomes bigger and bigger, then it suddenly colapses due to bursting. At once again the process is repeated. This is a contractile vacuole or pulsating vacuole. The animal is supposed to get rid of waste materials through its surface. The contractile vacuole helps in getting rid of excess of water in the animal body.

Reaction to Stimuli

Keep a few Amoebae in a petri dish. Throw a strong light at a spot where the *Amoebae* are present. It will be observed

that the animals move away from the strongly lighted portion of the dish to the less lighted portion. Similarly, if you add a crystal of common salt to a drop of water containing Amoebae the animals slow down in movement. These experiments show the response of the animals to the stimuli.

You have seen how an *Amoeba* puts out a pseudopodium to engulf food particles. If the false feet come across a sand particle it is ignored. The animal seems to know the difference between a sand particle and a food particle.

Reproduction

When the *Amoeba* has grown to its 'full size', it divides to form two Amoebae. The body constricts in the middle and the two halves are pinched off. Before this division, the nucleus divides into two, so that each daughter cell comes to have one nucleus. This sort of division is called binary fission. In this way the animal reproduces and forms new individuals.

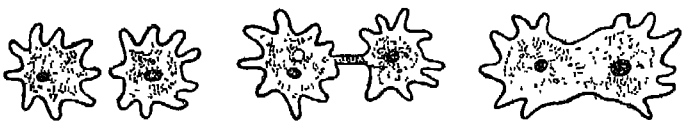

Fig. 3 3. Reproduction in *Amoeba* (binary fission)

PARAMECIUM

We have already studied about *Amoeba* which is a single-celled protozoan. Let us now study another animal which is slightly more complex.

If you examine a drop of water from a pond or ditch where dead leaves are decomposing. You will see a number of shipper-shaped animals moving about.

Structure

Focus the microscope on an animal which is not very active. The animal body consists of a single cell which is shaped like a slipper. When moving, it is the heel part which is kept forward.

It is always this end that is foremost and is said to be the anterior end. The animal has a number of hair-like structures all over its body. By the combined action of all these cilia the animalcule (small animal) moves. The shape of the animal is fixed. It cannot change like that of *Amoeba*. On one side of the body is a groove which is diagonally placed. The depression of this groove is also lined with cilia. The groove ends in a mouth. The cilia by their movements set up a current of water which 'sweeps in' food particles into the groove. The food consists of bacteria and other organic particles. Inside the body are seen two spherical structures, one bigger and

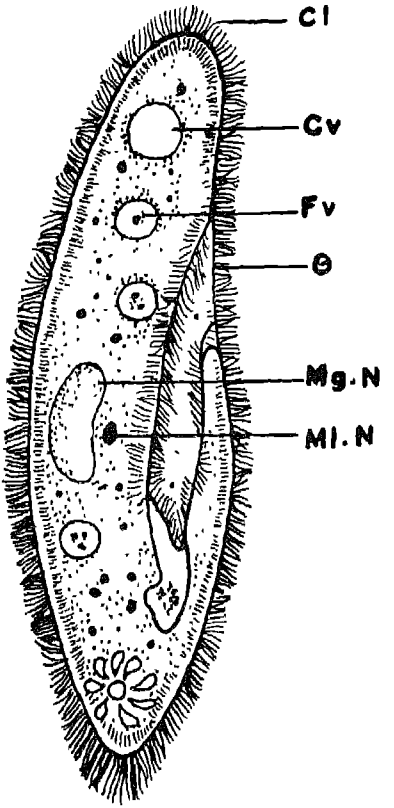

Fig. 3 5. Paramecium : Cl. Cv. Cv. C. . . . F.V. Food vacuole; Mi.N. M. . . . M. N. M. . . . G. Groove

another smaller. These are the two nuclei. The larger is the **meganucleus** and the smaller the **micronucleus.** The cell has also two **contractile** or **pulsating vacuoles.** Each vacuole has six smaller **radiating vacuoles** round it, the entire structure looking like a star-shaped body (Fig. 3.4).

The protoplasm itself has two parts. While the bulk of it is granular **medulla** the outermost layer is the denser and clearer **cortex.** Lying in the cortex are many spindle-shaped bodies called **trichocysts.** Add a small drop of iodine or Indian ink to the slide in which you are observing the *Paramecium.* You will find that delicate threads are discharged outside the body from the trichocysts. The Indian ink or iodine acts as an irritant. The threads are weapons of defence. They can paralyse the enemies of *Paramecium.*

Feeding and Digestion

The animal feeds on bacteria or other small organisms that live in the water. The cilia that line the groove set up a current in the water and the small organisms are swept into the groove and from there to the mouth. These particles along with a droplet of water forms the food vacuole. These vacuoles travel in this protoplasm due to its streaming movement. During this movement digestive fluids—enzymes—enter the vacuole and the food particles are digested. The undigested part is thrown out at a particular spot, when the vacuole reaches this point. This spot is considered as the **anal spot.** The digested matter in this vacuole is absorbed by the surrounding cytoplasm. The food so absorbed is used by the animal either to build up its body, or in producing energy for other activities. For the latter the food assimilated is broken down in respiration which is really an energy releasing process. Thus the moving food vacuole transports digested foods to the various parts of the body.

Respiration

The animal takes in food to build up its body and store energy but for other life activities, it requires energy. This

energy is obtained during respiration. Like all living beings *Paramecium* also respires. It breaks down food materials with the help of oxygen it absorbs through its surface. Energy is released during this break-down of food materials. Carbon dioxide is also produced which diffuses out of the body surface The dissolved oxygen in the water is absorbed and carbon dioxide is diffused out into the water.

Excretion

During respiration not only carbon dioxide is produced but also water. These two are waste products and they have to be got rid off. When proteins are broken down another waste product having nitrogen (ammonia) is also formed. The process of getting rid of waste products is known as excretion. Carbon dioxide and ammonia simply diffuse out into the water.

Paramecium, living in water, gets into its body more water than is essential. The excess of water is got rid off through the contractile vacuoles or pulsating vacuoles. Thus the concentration of water inside the cell is kept constant. Solid wastes are got rid off through the anal spot or the **anal pore**.

Response to Stimuli

Carefully keep under observation a moving *Paramecium*. (This can be done with a little practice under the microscope). When a *Paramecium* bumps into an obstruction like a sand grain, it backs up in the reverse direction for a short distance and again resumes the forward motion in an oblique direction. *Paramecium* also avoids unfavourable environment like water with too much salt or acid.

Reproduction

A *Paramecium* reproduces by simple binary fission. The two nuclei, macro- and micronuclei elongate and divide into two. The former divides by mere pinching off of its two parts.

The micronucleus divides by mitosis. It forms chromosomes which get duplicated and separated, so that each daughter

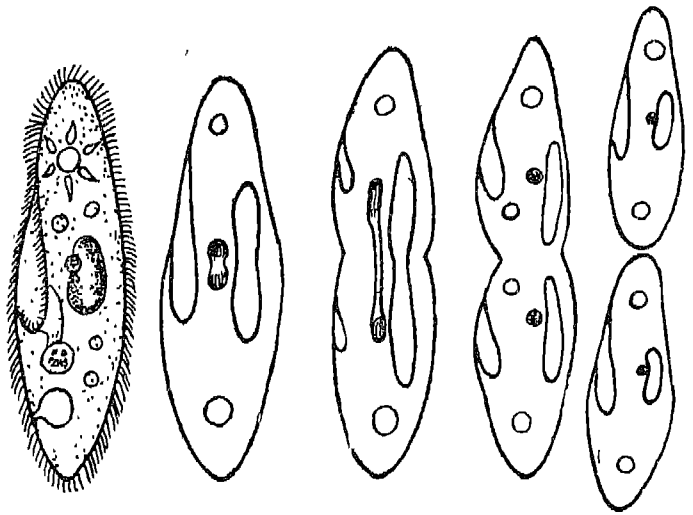

Fig. 3.5. Reproduction in *Paramecium*

nucleus has the same number of chromosomes as the parent nucleus. The body of the *Paramecium* now constricts in the middle This constriction grows inwards and divides the animal into two daughter individuals. Each daughter *Paramecium* comes to have one macro- and one micronucleus. The gullet or oral groove disappears before division and each daughter individual forms a new groove. Of the two contractile vacuoles, each offspring gets one and forms a new one later.

You have now learnt about the structure of two small animals in whom the body is made up of a single cell. This cell performs all life processes, like feeding and digestion, respiration, movement and reproduction. Each acts as a single organism. In other words *Amoeba* and *Paramecium* are single celled animals where the cell itself is the organism. The two show many differences between them.

Questions

1. Describe an animal which has only one cell as its body. How does such an animal carry on all its life activities?

2. How does an *Amoeba* catch its food? How is the food digested?
3. What are contractile vacuoles? Which of the animals you know, have contractile vacuoles.
4. Draw the figure of *Paramecium* and label the parts.
5. How is respiration carried on in *Amoeba* and *Paramecium*? What are the waste products of respiration? Why is respiration necessary?
6. Explain how an *Amoeba* moves.
7. How do *Amoebae* reproduce?

Tasks

Draw the figures of *Amoeba* and *Paramecium*. Name the parts.

Collect different samples of pond water and examine drops of them under the microscope. Make a list of the organisms you know.

§ 3. HARMFUL PROTOZOA

The two types studied, *Ameoba* and *Paramecium*, are free living, *i.e.* they live independent lives in water. Some other animals belonging to this group are found living only inside the body of another living being. They live inside in some cell or tissue and get all the food from the host. Such organisms are called parasites. Some parasites are harmless but most parasites are harmful and cause some disease in the host. There are some parasitic forms of Protozoa which cause disease in man. Malaria is caused by a protozoan which lives as a parasite in man. Amoebic dysentery (or amoebiasis) is caused by another Protozoa. Let us learn some facts about these animals. A knowledge about these is useful in preventing the disease.

Plasmodium (Malarial Parasite)

Most of you have heard of malaria. The patient suffers

from high fever and shivering. This occurs every 48 or 72 hours. It has been found that this fever is caused by a protozoan parasite known as *Plasmodium*. The parasite which is single-celled grows and multiplies in the red blood corpuscles of human blood. When it reproduces it forms several small

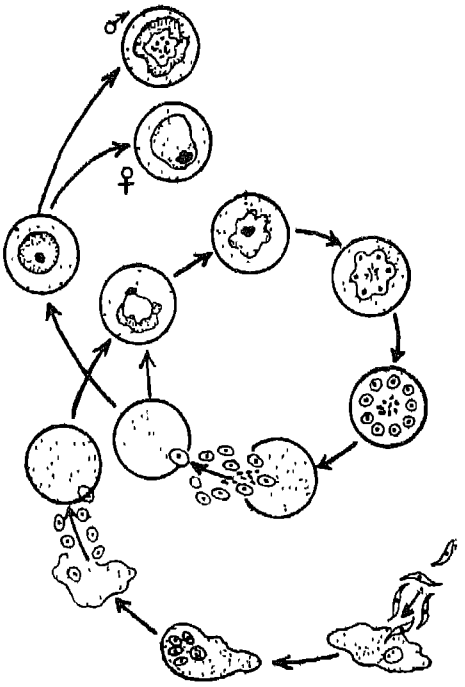

Fig 3·6. Some stages in the life cycle of malarial parasite

daughter cells or **merozoites**. These escape by bursting the corpuscle which is thus destroyed. As many red cells burst at the same time the merozoites along with some toxic substances are set free in the blood. It is during this release of the merozoites that the temperature of the patient shoots up and he shivers. The released merozoites attack new blood cells and repeat the cycle every 48 or 72 hours.

How does the parasite first get into the body of man? Scientists at first did not know the cause of malaria. People in the olden days thought that malaria was caused by breathing

foul air. Only in 1880, a French surgeon discovered the parasite *Plasmodium* in the red blood cells of a patient. But even then no one knew how the disease passed on from man to man.

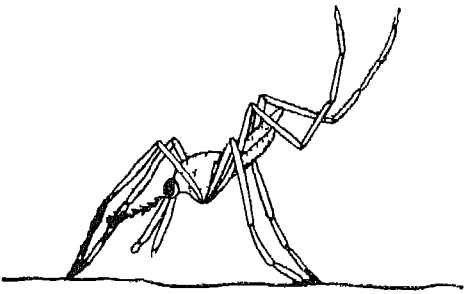

Fig. 3.7. Anopheles mosquito (female)

It was Ronald Ross, a British Army doctor stationed in Hyderabad who proved that the malarial parasite passed part of its life-cycle inside the body of a mosquito—*Anopheles*. He also proved that when a mosquito bites a patient suffering from malaria, it sucks the blood and some parasites along with it. These parasitic cells develop further inside the mosquito. Later when this mosquito bites a healthy man the parasite cells are injected into the blood stream of the victim through the salivary glands of the mosquito. For his discovery Ross was awarded a Nobel Prize in 1902.

It is interesting to learn that it is the female mosquito that bites and sucks blood out of man. It has special mouth parts to do it. The male mosquito usually lives on plant and fruit juices.

It has been already stated that the parasite develops further inside the body of the mosquito. When a mosquito sucks the blood of a malarial patient, the parasitic cells enter its stomach and pass the second part of life-cycle. After a few changes in development the parasitic cells get embedded in the stomach wall of the insect. The cells again divide into small spindle-shaped cells which enter the blood stream of the mosquito. Gradually, they reach the salivary glands.

When the mosquito bites a man the parasite passes along with the saliva into the patient's blood vessels.

Thus the malarial parasite requires two hosts to complete the life-cycle. If we prevent mosquito breeding we can control malaria. Swamps and open drains are ofted sprayed with oil to prevent mosquito breeding. People should sleep under mosquito nets in places where mosquitoes are a nuisance and exist in large numbers.

The patients may be given drugs like quinine or paludrine to check the disease.

Entamoeba

Another disease caused in man by a different protozoan is amoebic dysentery (aimoebiasis). The disease causes pain in the abdomen and the patient has several motions. With each motion he passes out lot of blood and mucus.

The *Entamoeba* (*E. histolytica*) looks like *Amoeba* to some extent. It forms cysts (thick-walled structures) in the stomach of the patient It enters the large intestine and destroys some part of the wall of the intensive. This damage causes the accumulation of mucus and blood which is passed out with the stools. To prevent the disease one should drink boiled water and eat well-cooked food.

§ 4 DIFFERENCES BETWEEN PLANT AND ANIMAL CELLS

In an earlier class you studied about plant cells and their structure. In the earlier lessons of this chapter you have learnt about some animals which are single-celled. Are the animal cells similar to plant cells in structure ? Let us compare and see the differences, if any, between them.

You have learnt that the plants have a cellular structure. All plants and plant organs are made up of cells. You will find out that all animals are also made up of cells. *Amoeba* and *Paramecium* are uni-cellular animals. There are other animals which are multicellular. Are the cells of plants and animals similar or are they different ?

Let us recall briefly the structure of a plant cell. The cell consists of a bit of protoplasm which is enclosed by a cell-membrane. This membrane gives the cell a particular shape. Outside the cell membrane is a wall. All plant cells have a cell

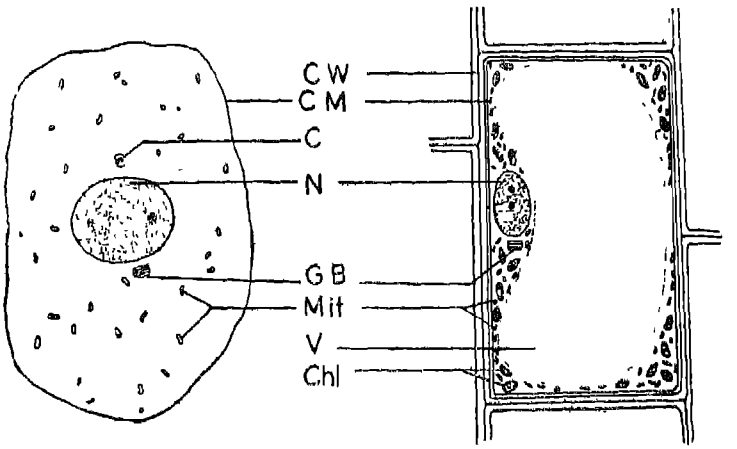

Fig. 3.8. An animal cell (left) and a plant call (right). Cw—Cell well Cm—Cell membrane, C—Centrosome, N—Nucleus, Gb—Golgi bodies, V—Vacuole, Chl—Chloroplast.

wall. The protoplasm is differentiated into a central nucleus, a denser body, and the surrounding cytoplasm. In the cytoplasm are often found plastids, i.e. chloroplasts, chromoplasts or leucoplasts. Besides these, the plant cell has also vacuoles which are spaces filled with a fluid.

The animal cell consists of a little bit of protoplasm limited by a cell membrane. But the animal cell has no cell-wall. The cell has a nucleus and cytoplasm, but there are no plastids. Vacuoles are smaller and less in number. The animal cell also has a small structure by the side of the nucleus. This is called a centrosome and it plays a part when the nucleus divides. Plant cells do not have centrosomes. You can now make a list of all the similarities and all differences between the structure of an animal cell and that of a plant cell.

SUMMARY

Some protozoans are harmful to man as they cause diseases. *Plasmodium* causes malaria and it passes its life cycle in two hosts, man and mosquito. The mosquito acts as a transmitter of the disease. Amoebic dysentery is another disease caused by *Entamoeba histolytica*.

The plant cell and the animal cell have the same basic structure. A bit of protoplasm is enclosed by a cell membrane There is a nucleus and cytoplasm with a few inclusions. But a plant cell has a cell wall which is absent in an animal cell. Tne plant cell also has plastids and vacuoles. Animal cells have no plastids, and vacuoles are less in number and smaller in size. The animal cell has a centrosome near the nucleus.

Questions

1. Name some harmful protozoans and the diseases they cause. What steps would you take to control the diseases ?
2. What is the role played by the mosquito in spreading malarial disease ?
3. List out the similarities and differences between the structure of a plant cell and an animal cell.

Tasks

1. Study the chart of the life cycle of a malarial parasite. Note how man can avoid malaria.
2. Draw the figures of a plant cell and an animal cell to bring out the differences. Label the parts.

CHAPTER IV

Coelenterata

In the last chapter we studied about single-celled animals. There are more complex animals which are multicellular. The Coelenterata is a group of animals who have multicellular bodies.

§ 1 HYDRA

Collect some water from ponds where plenty of plants are growing. Take care to see that you bring in the vegetation also from the pond along with the water. Keep it in a beaker in the

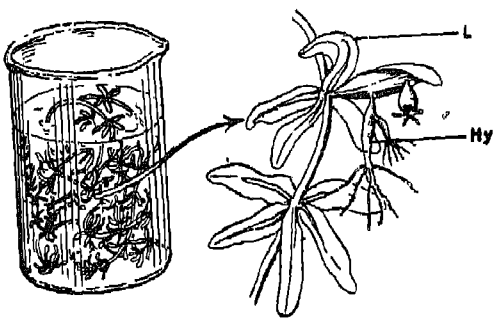

Fig. 4.1. *Hydra* attached to an aquatic plant

classroom. You may find small thread-like structures about 1.5 cm or less in length sticking to the leaves or twigs of plants in the water (Fig. 4 1). Examine these with a lens. At the tips of these structures you will find 5-6 thin branches arising in a bunch. This is an animal known as *Hydra*. The thread-like structure is the body and the branches are its **tentacles.**

Keep the animal still attached to the leaf and watch it under a lens. You may find the animal moving.

Movement

Normally the animal is attached to any object in water, leaf, stone or stick. When undisturbed you will find the tentacles swaying in the water; and occassionally one of these may be pulling a bit of food particle towards the base of the tentacles. The tentacles surround a small protruding tip of the animal body. It has an opening which is really the mouth of the animal. The tentacles pull bits of food particles towards the mouth.

The animal is also capable of bodily moving from place to place. The whole body bends and the animal catches the substratum by its mouth end. The base is now detached and it swings and sticks at another place Once this is done the anterior end (mouth) is released By repeatedly doing this the animal moves. In another movement the animal appears to somersault (Fig. 4 2). Sometimes the animal gets completely

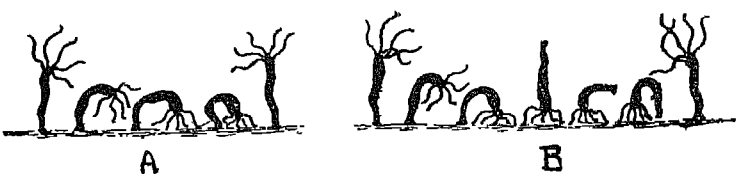

Fig. 4.2. Locomotion in *Hydra*. A Looping, B. Somersaulting

detached and is drifted for some distance. When it catches hold of any solid surface it once again gets attached.

In order to observe how a *Hydra* catches its prey and feeds, you may introduce some small animals like *Daphnia* in a trough containeing *Hydra*. You will find that when a *Daphnia* comes near the *Hydra* and happens to touch its tentacles, it is first stunned. It is not able to move anymore. Tentacles are drawn around the prey which is gradually moved to the mouth of the animal situated at the top of the body and at the base of the tentacles. The entire animal will pass into its body. At one time it may swallow several animals of the type of *Daphnia*.

Structure of the Body

We have already stated that *Hydra* is multicellular, i.e. its body is made up of many cells. Let us learn how these cells are placed and what is their function. With the help of your teacher examine a longitudinal section of *Hydra* (a prepared slide) under a microscope.

You will find that the body of *Hydra* is bag-like. The walls of the bag seem to be two-layered. The outerlayer composed of smaller cells is called the **ectoderm** and the inner layer having bigger cells constitutes the **endoderm**. The two layers enclose a large internal cavity called the **enteron**. If you examine closely, you may find that in between these two

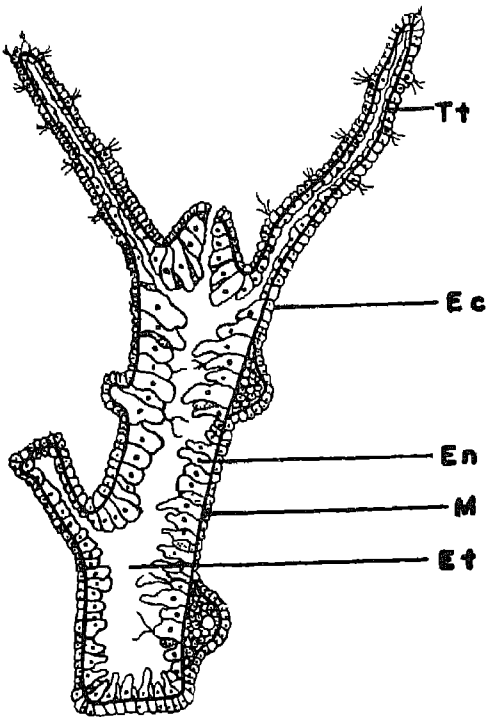

Fig. 4.3. Hydra—internal structure ; TF—Tentacles , Ec—Ectoderm ; En—Endoderm ; Mesogloea, Et—Enteron.

layers of cells, there is a non-cellular gelatinous layer. This layer is called **mesogloea.**

The cells in both the layears have slender processes which are capable of contracting. These processes run along the mesogloea. By the contraction or elongation of these processes the animal is able to contract or stretch its body. In between the cells of the ectoderm are some special cells. These are **stinging cells (nemastocysts).** They are smaller and are found embedded in between the larger epidermal cells. Each stinging cell is like a sac with a long coiled structure inside it. The sac has a sensitive hair projecting to the outside. When an organism comes near and touches this hair, the coil is thrown out. It pierces the organism and injects poisonous fluid into it. The paralysed organism is then taken to the mouth.

The tentacles have the same structure as the body. They are two-layered and have a central cavity. Stinging cells are more numerous on the tentacles than on the body.

Digestion

You have already learnt that the *Hydra* has a mouth and a large internal cavity or enteron. The food that is pushed by tentacles into the mouth passes into the enteron. The endoderm cells line the enteron. Some of these cells have protuberances or pseudopodia and some have hair-like projections. By the movement of these hairs the fluid inside enteron is kept circulating. The pseudopodia catch any food particles that may pass near them and engulf them. These food particles are digested in the cells. At the same time digestive fluids are passed into the enteron and other food particles are digested and absorbed. The particles which are not digested are taken up in the current and are thrown out through the mouth. Thus the entry of food and the throwing out of undigested food take place through one opening viz., the mouth.

Respiration

The exchange of gases in respiration takes place through

the surface of the cells. There are no special organs for either respiration or for excretion.

Irritability

Like all other living things *Hydra* also shows response to several stimuli. You have already learnt how the tentacles are sensitive to food particles in the water and respond to the stimulus by catching the prey with the help of the stinging cells. In a similar way if any harmful animal or thing is in its way or touches it the whole body of *Hydra* contracts to form a litttle lump and the tentacles also shrink to buds. When the danger passes the *Hydra* resumes its normal shape.

Reproduction

How does this multicellular animal reproduce ? There are two ways in which the *Hydra* produces new ones. In one method no sex is involved. On the body of the *Hydra* small bud-like outgrowths start. This is hollow in the middle and is two layered in cells. The outgrowth elongates and develops into a tiny *Hydra* with tentacles and mouth. This baby *Hydra* later on gets detached and becomes fixed in another place and starts as a new individual.

In the other method the *Hydra* produces **gonads** which are organs which develop gametes or sex cells. In your lessons in botany you have learnt how a seed is formed. For this, an essential process is fertilization of the egg with a sperm cell. The egg cell is formed in the ovule and the sperm cell is formed in the pollen grain (in the pollen tube). The pollen grains in turn are formed in anther and the ovule in the ovary. This is an example of sexual reproduction in plants.

In almost all animals there is sexual reproduction. *Hydra* also has such a method. The same *Hydra* (individual) forms sperm producing testes and the egg producing ovary. Thus *Hydra* is bisexual or is said to be a **hermaphrodite**. The testes are formed as protuberances. The structure produces

numerous sperms which are set free in the water. The eggs are produced in ovaries which are also many-celled organs developed on the same *Hydra* or on a different individuals. Each ovary produces one egg which is surrounded by other cells When the egg is ripe the other cells separate and leave an opening. The sperms swim towards the egg and finally one sperm fuses with the egg cell. This is fertilization.

The fertilized egg undergoes several divisions till a hollow sphere of cells is formed. Then this sphere starts folding in at one end till a double layered structure is formed. This later develops into an adult *Hydra.*

§ 2. HYDRA — A MULTICELLULAR ORGANISM

Organisation of Tissues

You have seen that in *Amoeba* and *Paramecium* a single cell behaves like a complete organism and does all the work of an individual animal. *Hydra* is multicellular. What is the need of a number of cells to form a single animal ? Do all cells function in the same manner ?

From a study of the structure of *Hydra,* we have found that the many cells have a pattern in their arrangement. All cells do not do *all* functions While some cells, like those of the ectoderm, are protective in function, others like those of the endoderm are digestive and absorbtive. The cells of the tentacles, though they appear similar, do not take part so much in the work of digestion The stinging cells give protection to the animal and help it to catch its prey. Thus some cells do certain functions while others perform different functions. On the whole the animal behaves like one individual. This sort of distribution of work is called division of labour. The work is divided well among all cells. All cells do not waste there energies to do all work. Each does its assigned work for the benefit of the whole individual. Still, as regards respiration and excretion all cells do this work. The cells of the endoderm also catch food particles and digest them if any food particle comes near them.

The division of labour has just begun in *Hydra*. The cells set apart for a particular function are together called a tissue. The ectoderm and endoderm are different tissues.

§ 3 SOME COMMON COELENTERATES OCCURRING IN THE SEA

The *Hydra* described earlier is a fresh water coelenterate. But one must go to the sea-shore to get an idea of the numbers of coelenterates that inhabit the seas. If you visit a sea-shore after the tide has receded you will see beautifully shaped, colourless and coloured coelenterates, big enough to be seen. Take care, and do not handle them without precaution. Many of them will sting you and cause pain. Among the marine coelenterates may be mentioned the jelly fishes, the sea anemones and the corals.

The jelly fishes are trantparent hemispherical, dome-shaped animals with a number of hanging tentacles. When alive you can see the body pulsating like a throbbing machine. In size they may be from a few centimetres to even a metre across. When waves have receded on the sea beach you may find several jelly fishes cast helplessly on the sand.

The sea anemones are attached to rocks or the sand bottom and have beautiful colours. The whole animal looks like a beautiful flower. The name anemone is given because of this flower-like appearance. From the anterior end come out the beautiful tentacles brightly coloured. If you visit any aquarium you will enjoy seeing the sea anemones.

The corals are colonial coelenterate animals. That is, the animals live in great colonies forming beautiful masses of finger-like projections. The animals secrete lime skeletons to the exterior and these collectively take on beautiful shapes. Dead corals are used in jewellery.

SUMMARY

The coelenterates are multicellular animals. *Hydra* is a coelenterate. Its body is two layered, the outer layer of cells being the ectoderm and the inner the endoderm. These layers

enclose a large internal cavity called the enteron. Between the two layers is a substance called mesogloea. The animal shows a peculiar movement Its tentacles help in catching the prey and bringing it to the mouth. The food is digested in the enteron and absorbed. The remnants are thrown out of the mouth.

In the ectoderm are the stinging cells. With their help the prey is paralysed. When a foreign body touches *Hydra* it responds by contracting to a lump and it stretches again when the danger is passed.

Hydra reproduces by budding in one method. In another, the animal produces gametes (sex cells) in special structures called gonads. The sprem swims and fertilizes the egg in the ovary. The fertilized egg develops into a *Hydra.*

Hydra is a multicellular animal and it exhibits division of labour among the cells.

The sea abounds in a variety of beautiful coelenterates. The jelly fishes, corals and sea anemones are marine coelenterates.

Questions

1. Describe the structure of a multicellular animal that you have studied.
2. Where do you find *Hydra* in nature ?
3. How does *Hydra* catch its prey ? How are tentacles useful to the animals ?
4. How do *Hydra* reproduce ?
5. Explain the term division of labour. Name an animal which exhibits this feature ? What is the advantage of this ?
6. Name two coelenterates which are found in sea.

Task

Collect some pond water along with *Hydra.* Bring them to your classroom and watch how these animals feed and move.

CHAPTER V

Worms

The term worm usually refers to the backboneless animals that creep, crawl or wriggle. Worms are of many different kinds. You are all familiar with earthworms. Earthworm is a kind of worm. It lives in the soil. There are many other kinds of worms living in soil, in ponds, in rivers and seas. Such worms are called free-living worms. Other worms live as parasites in man or animals. Parasites are organisms that live on other organisms for food and shelter. Organisms that harbour the parasites are termed the hosts. Parasites may be found on the external or the internal parts of the body of animals. Some parasites occur inside the human body too. You might have heard of a doctor treating someone for worms. This is to get rid of worms living as parasites in that person. Tapeworms and roundworms are parasites found in man.

§ 1. TAPEWORMS

Tapeworms are of various kinds. One kind lives inside the intestine of the human body. These are called tapeworms because they are flat and resemble a long strip of tape. The body seems to be made up of small pieces which are connected end to end. The tapeworm in man is long, sometimes measuring 2-3 metres. One end of its body is attached to the inner wall of the intestine. This end is its head or **scolex**. The head is very small and is the size of a pin-head. How does the worm attach itself to the intestine ? If you examine its head under a lens, you will find a circlet of small hooks at its top, and four cup-like depressions at the sides. These depression are called **suction discs**. It is with the help of the hooks and suction discs, that the animal is able to attach itself to the intestine (Fig. 5.1).

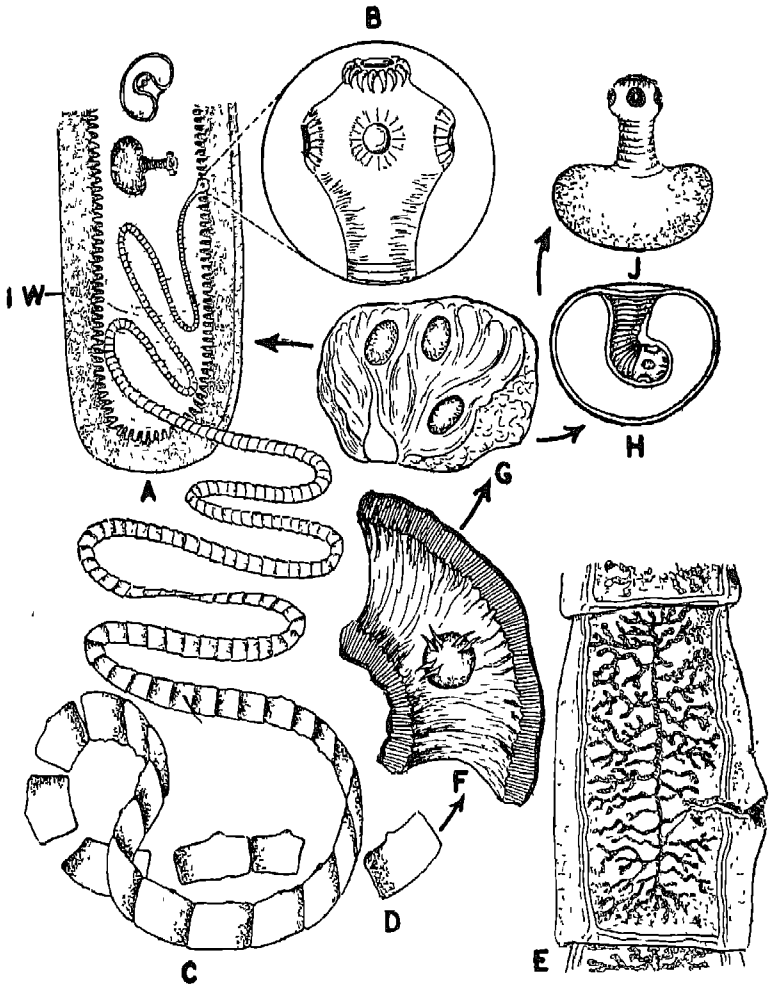

Fig 5 1. Tapeworm · life cycle. A. Adult tapeworm ; B. The head of the worm enlarged ; C The posterior segments of the worm D. A single body segment ; E. Magnified view of a segment ; F. The embryo of tapeworm inside the intestine of a pig., G. Cysts formed in the pork, H&J. Bladder worms

The head is followed by a thin neck. The width of the body gradually increases from the neck downward. There are as many as one thousand segments in the body of a single worm.

How does a tapeworm obtain its food ? The worm is a parasite and lives in the intestine of the host, and it is surrounded by partially digested food. It simply absorbs this food through its entire surface. Therefore, there is no need for digestion of food inside the body of the worm. The tapeworms have no digestive canals.

Persons infected by these tapeworms are deprived of some of their food. The parasites also throw some waste products into the intestine of their hosts. The waste products are harmful to the human body. The loss of some food and presence of harmful substances cause anaemia in man. Such persons look pale and thin and feel weak and exhausted.

Life Cycle

You have learnt that the tapeworms live inside the small intestine of man. How does it infect a new victim ? To understand this, you must know their life cycle. The segments of the body particularly those found at the free end of the body, develop thousands of eggs inside them. These segments with the eggs get detached from the body of the worms. A man infected with tapeworm expels ripe segments full of eggs almost every day along with the faecal matter. On rupturing of the bag, the eggs are liberated in the soil.

The faecal matter along with the eggs of the worms might get mixed with the food of pigs and reach the stomach of the pig. In the stomach the digestive juices dissolve the outer covering of the eggs. From each egg a minute young one comes out. These young ones do not resemble the adult tapeworms. They are the larvae. These look like bladders and hence are called **bladder worms.**

The larvae of tapeworm have six small hooks. These hooks help the larvae to puncture the inner walls of the stomach. Then they get into the blood. The blood carries them to different parts of the body of the pigs. These finally reach and settle in the muscles. In the muscles they surround themselves with thick walls and become cysts. When man

eats partially cooked pig's meat the cysts develop into tapeworms. The tapeworm thus has two hosts. You have learnt that these parasites spend part of their life inside the body of the pig and another part in man. The pigs are called the *intermediate hosts*. There is another kind of tapeworm that has the cattle as the intermediate host.

Protection Against Tapeworm Infection

(*a*) The pork and beef should be properly inspected by the health authorities. There might be meat infected with the bladder worms (larvae). Such meat should not be released for sale.

(*b*) The pork and beef should be properly cooked. This will kill the worms that may be present in the meat.

(*c*) Passing of stools in the open places and streets should be prevented.

(*d*) Proper care should be taken to prevent the food of pigs and cattle from getting contaminted with human excreta.

(*e*) Cattle and pigs should not be allowed to stray about.

SUMMARY

Worms are crawling or creeping animals which have no backbones. Some are flat, some are round and some others are segmented. Some of them are parasites. Parasitles are adapted in different ways for their peculiar way of life.

Tapeworms are long parasitic worms living in the intestine of man. They have minute head and gradually broadening body. With the help of hooks and sucking discs they remain attached to the intestinal wall of man. They obtain their nutrition by absorbing the semi-digested food of man.

The eggs develop in large numbers inside the hind segments of the worm. These segments are expelled to the outside along with the faecal matter. The eggs get contaminated with the food of cattle or pigs and reach their intestines. The larvae are liberated and they finally reach the muscles of the

intermediate host. They lie quietly as cysts in the muscles till they reach the intestine of man. Prolonged cooling or heating of beef or pork kills the bladder worms present in them.

Questions

1. What is a parasite ? How is tapeworm a parasite ?
2. How does a tapeworm attach itself to the inside wall of the intestine ?
3. There is no need for a food canal in tapeworms. Can you explain why ?
4. What are the several adaptations of the tapeworm for its parasitic way of life.
5. What are the preventive measure to be taken against tapeworm infection ?

§ 2. ROUNDWORMS

We have learnt earlier about tapeworm which is flat. There are other parasitic worms that have cylindrical bodies. Such worms are called roundworms. *Ascaris* is a roundworm parasitic in man's intestine. It has a long and cylindrical body which is pointed at both ends. It reaches a length of 25 to 35 cm, and four to six millimetres in thickness.

You have seen that the tapeworms have no food canal. But *Ascaris* has a food canal. It is a simple tube extending from the mouth to the anus. The worm sucks up the content of the intestine. The worms have no digestive glands because they take in semi-digested food in the intestine.

There are separate male and female worms among the roundworms (Fig. 5.2). Each female worm can lay about 20,000 eggs in a day. The eggs are passed out of the intestine along with the faecal matter.

The eggs of the worms might get mixed with the soil or water.

These eggs can remain alive for a long time in the soil. They are not easily affected by heat and cold. They might get mixed with our food in many ways.

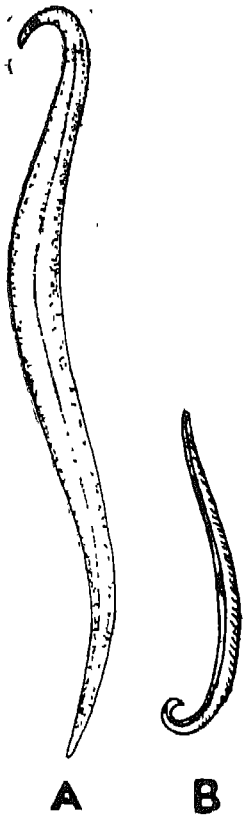

Fig. 5.2. Roundworm : I—Intestine, R.W.—Roundworms. A—Female ; B. Male

The compost made out of human excreta is sometimes used as manure for growing fruits and vegetables. Thus the soil of these fields might contain eggs. When the vegetables and fruits grown in these soils come in contact with the soil, the eggs adhere to them. When these vegetables are eaten raw or without being washed, the eggs enter the digestive canal of man. Sometimes children drop their eatables like biscuits and sweets on the soil. If the soil contains the eggs, it might adhere to these eatables. When children eat these biscuts the eggs get an entry into the food canal.

Children are more susceptible than adults to the attack

of large number of worms. They become anaemic since the worms consume a large portion of the food they take. When present in enormous numbers the worms block the passage of intestine (Fig. 5.3.).

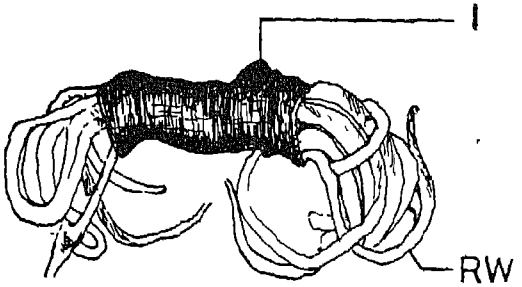

Fig. 5.3. A small protion of the intestine of man clogged with roundworms
I—intestine ; RW—Roundworms.

Prevention of Roundworm Infection

The infection of roundworms can be prevented by adopting the following measures.

(*a*) Washing the fruits and vegetable before eating.

(*b*) Cooking fruits and vegetables.

(*c*) Preventing people from passing stools in open places.

(*d*) Preventing children from eating biscuits, sweets and similar things that are dropped on soil.

§ 3. PINWORMS

Pin worms are white little worms, often seen wriggling in the stools of infected persons. They are about one centimetre in length and are as thick as a pin. They live in certain parts of the large intestine. The mature worms travel down to the anus and deposit the eggs at the outer edges of the anus. Their movement and egg deposition cause itching sensation to the host. They scratch the anal region with their fingers. While scratching, the eggs get themselves lodged in the crevices of finger nails. Some people do not clean their fingers properly

and handle food materials. Thus the eggs of these worms get mixed with food. When these food materials are eaten, the young ones of these worms hatch out in the food canal and reach the large intestine where they live.

Prevention of Pinworm Infection

The infection by pinworms can be prevented by adopting the following hygienic practices.

(*a*) Periodically cutting the nails and thoroughly washing hands before eating.

(*b*) Refraining from scratching the anal region.

(*c*) Immersing undergarments of infected persons in boiling water before washing and drying.

Helminthology as a Science

You know a large number parasitic worms and their way of life. This knowledge has accumulated as a result of the constant investigations by certain scientists. The study of the parasitic worms is known as **Helminthology**. The knowledge thus gained is useful to us in preventing infection by many parasitic worms that cause diseases in man and domestic animals.

A knowledge of the life-cycles of these worms has helped man in devising various drugs to control and eliminate parasitic infection in man and domestic animals.

SUMMARY

Roundworms are cylindrical parasitic worms, that infect the food canal of human beings. They are adapted for leading a parasitic way of life inside the human body. They have a food canal. They suck the semi-digested food from the stomach and intestine of human beings. There are both male and female worms. Another parasitic worm in the intestines of man is the pinworm. Pinworms are tiny animals.

Questions

1. In what respects does the life history of a roundworm differ from that of a tapeworm ?
2. How is a roundworm adapted for its parasitic way of life ?
3. What measures should people take to prevent themselves and others from getting infected by roundworms ?
4. (*a*) What is the study of parasitic worms called ?
   (*b*) How can the knowledge of parasitic worms help in relieving the sufferings of man.

Task

1. Examination of the specimens of roundworms and pinworms.
2. Visit to a nearby health museum, Vigyan Mandir, hospital, school or college to see the specimens of intestine of man clogged with roundworms.
3. Study of the life cycle of roundworm with the help of wall chart.

§ 4. EARTHWORM

You are familiar with earthworms. You might have seen them while digging the soil in the garden. Have you noticed them crawling on wet ground after heavy rains ? Earthworms live under the soil. Their homes are deep, long narrow burrows beneath the ground. They are found most abundantly in places where plants are rotting. They usually remain inside their burrows during the day time. They cannot withstand the heat of the day time. They come out of their burrows only during nights. During the daytime they come out when their burrows are filled with rain water.

External Structure

Have you ever observed an earthworm closely ? An earthworm looks very simple externally. Its body is long and

cylindrical. There seems to be no difference between its head and tail.

Note the differences you find between the external appearance of an earthworm and that of a roundworm. The body of an earthworm is made up of many rings. Each ring is called a segment. There are no segments in the body of the roundworms. The body of the earthworm is smooth and moist. Which is its front end ? Take an earthworm and allow it to move on the ground. The end which is directed forwards while moving is its front end. Does an earthworm always move by its front end ? Divert a moving earthworm by pricking it with a pin. The worm can move both forwards

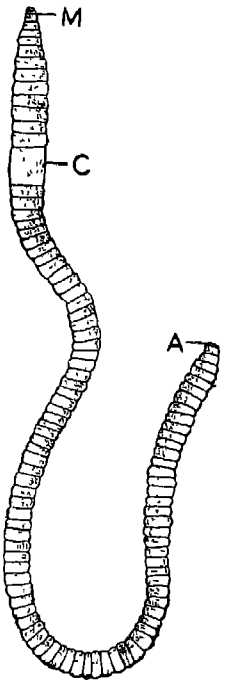

Fig. 5.4. Earthworm : M-Mouth ; C-Clitellum ;A-Anus

and backwards. In adult worms, there is a thickened portion near its front end. This portion is called *clitellum.* Turn over an earthworm. Can you make out its underside ?

Observe it turning back again. You may not find out, but the earthworm knows which is its belly side and which is its back.

Feel the earthworm gently with fingers. You will find that the body is soft. It has no bones. The body can be stretched to some extent like an elastic band.

Have you ever noticed birds trying to pull out an earthworm from its burrow ? Try to pull out gently an earthworm from its burrow. You will realize how firmly the worm is fixed to the wall of its burrow. Slowly pass an earthworm between your fingers from the tail end forwards. Do you feel the presence of small bristles on its body. It is with the help of these bristles that the earthworm moves from place to place.

Movement

Watch an earthworm moving. It fixes the hind part of its body firmly on the ground with the help of bristles. Then its front end is extended. Next the front part of the body is fixed, the hind part is released and drawn forward. By repeatedly performing such activities, the earthworm moves from place to place.

Feeding and Digestion

The food canal of the earthworm is a long, straight tube. The mouth leads into a dilated portion called **pharynx**. The **oesophagus** is a narrow tube extending between the pharynx and the **crop**, which is elastic and spacious. It serves as the store-house for the food eaten by the worm. Behind the crop is the **gizzard**. The gizzard is a thick-walled chamber used for grinding the food. The rest of the tube following the gizzard is the intestine (Fig. 5.5).

The earthworms swallow soil. The soil containing decaying parts is passed unchewed through the mouth. It then reaches the crop, where it is stored for sometime. Then the food enters the gizzard, where it is ground to a fine pulp. When the food passes along the long intestine, the digestive juices are poured into it and the food substances present in

the soil are digested and absorbed. Have you ever seen small pellets deposited near the openings of the burrows of earth-

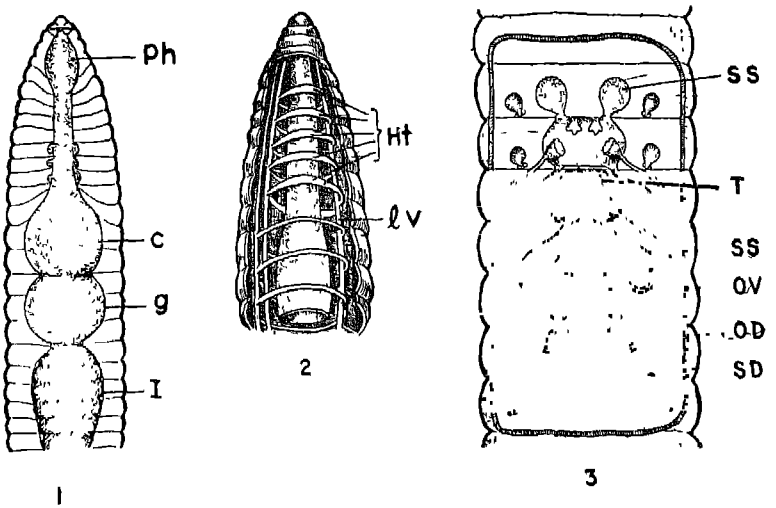

Fig. 5.5 Earthworm · 1. Digestive system—Ph—Pharynx ; C—Crop ; G—Gizzard ; I—Intestine ;
2. Anterior end of earthworm showing blood vessels Ht Heart ; L.V. Longitudinal vessel
3. Reproductive system. S S —Sperm sac. T—Testes , O.V—Ovaxy ; O.D. Oviduct ; S.D. Sperm duct

worms ? These are called worm casts. You can see them well in the mornings. These are the undigested particles of soil.

Circulatory System

Closely observe the body of an earthworm. You can see blood vessels which are red in colour. There is a long vessel over the food canal extending from one end to the other. This vessel collects the blood from the different parts of the body. The vessel contracts and pushes the blood forwards. On the belly side there is another long vessel. This is not capable of contracting. This is the main distributing vessel. The blood flows backwards in it. Various parts of the body of the eartnworm are supplied blood from this vessel. In the region of the oesophagus, the two main vessels are connected at the sides by five pairs of hearts. These hearts pump the

blood through the main ventral vessel. Behind the oesophagus in each segment there is a small vessel which connects the two main vessels through a network of capillaries.

Respiration

The taking in of oxygen and giving out of carbon dioxide take place through the moist skin.

Nervous System

A long, double nerve cord extends along the ventral side of the body. It is thickened in each segment. The thickened part is called a **ganglion**. From each ganglion nerves to different parts of the body are given out. At its front end, the nerve cord has an enlarged ganglion. This is connected by two nerves to another large ganglion situated above the pharynx. This large ganglion represents the brain of the earthworm.

Reproduction

Each earthworm has two pairs of testes and one pair of ovaries. The male cells produced by the testes become sperms in the sperm sacs. Ova or eggs are produced in the ovaries.

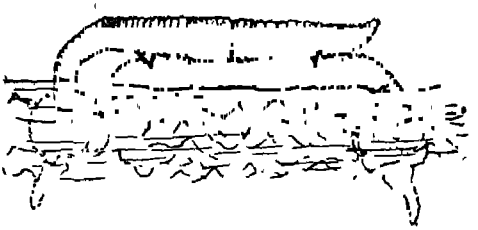

Fig. 5.6 Mating in earthworms.

Such an animal in which the male and the female sex organs are present in the same individual is called an **hermaphrodite** animal. Earthworm is an example of an hermaphrodite animal.

Two earthworms come in contact with one another. They get attached to each other along their thickened part called the **clitellum**. Each worm releases the sperms which are stored in the sperm receptacles. Then the worms separate.

Earthworms lay eggs. At the time of egg laying the clitellum secretes a thick mucous substance. This gets detached as a ring and glides forwards on the body. As it passes, it receives the ripe eggs and sperms. Fertilization, which is the union of eggs and sperms, takes place in the mucous ring. The mucous ring slips out of the worm. The open edges are sealed to form **capsules** or **cocoons**. The capsule is left in the soil. Each fertilized egg develops into a young worm. The capsule ruptures and the young ones escape.

Economic Importance

Have you heard of earthworms being called farmer's friends. They are also called nature's plough. How can these tiny earthworms do any good to the soil ? You should know that in each acre of land, there are many thousands of earthworms. They go on making tunnels inside the earth. These tunnels bring air to the roots of plants. The soil is well aerated.

The roots are always buried inside the soil. They need air for respiration. The tunnels made by earthworms also enable the rain water to trickle down deep into the soil.

The castings of earthworm form good manure for the plants. Plants grow well in soil containing plenty of castings.

Segmentation

You have seen that the body of the earthworm is made up of segments. The segments are not merely superficial. The segmentation goes deep even in the inside of the body. Corresponding to each segment, there is a septum that divides the body inside into chambers.

You have learnt that the tapeworms are flat. Compared to *Hydra*, the tapeworms have definite heads. The body of

Hydra shows radial symmetry. If you cut a flatworm along the central plane you will get only two similar halves. Such a type of symmetry is called **bilateral symmetry.**

The body of roundworm is cylindrical. It is not divided into segments. The body of the earthworm resembles a roundworm in having a cylindrical dody, but it is made up many rings or segments. The internal organs are much more complex than those in tapeworms and roundworms. The bodies of roundworms and earthworms are also bilaterally symmetrical.

SUMMARY

The earthworms are segmented worms living in moist soil. The segmentation is deep even inside the body. Earthworms eat the soil containing decaying plant parts. The excreta of the worms called 'worm-casts' form good manure for plants. Earthworms help to aerate the soil.

They move from place to place with the help of minute setae found all over their body. They have a double nerve cord running along the ventral side of their body. The blood is red and circulated in closed vessels. They respire through moist skin.

Earthworms are hermaphrodite animals. They lay eggs in the soil which develop into young ones.

Questions

1. Why do earthworms go deep into the soil during dry seasons ?
2. You should dig for earthworms with a spading fork and not with shovel. Why ?
3. Why do the birds find it difficult to pull out earthworms from their burrows ?
4. What is meant by bilateral symmetry ? Explain it with the example of an animal you have studied.
5. The ganglia of the nervous system are :